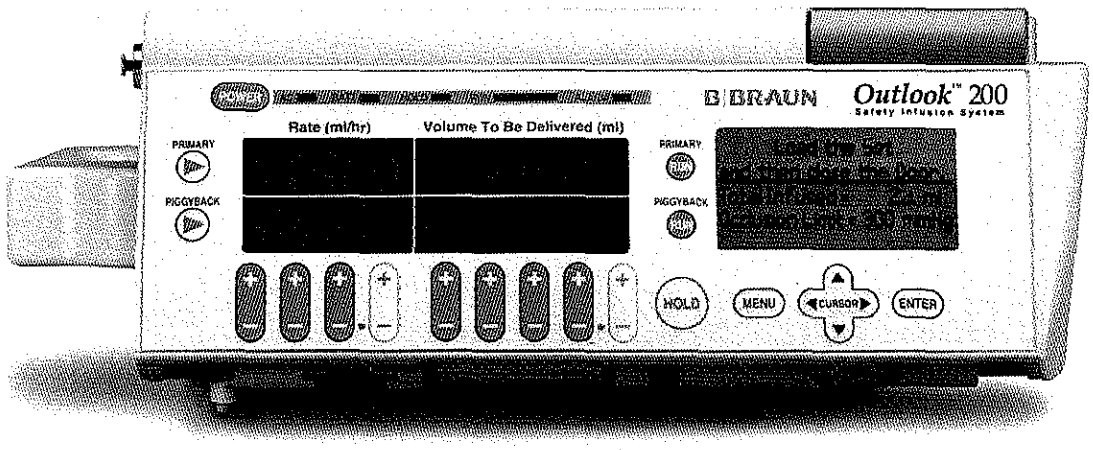
OUTLOOK™ 200 SAFETY INFUSION SYSTEM

SERVICE MANUAL



Rx Only

B|BRAUN
SHARING EXPERTISE

950953 Rev B (9/04)

OUTLOOK™ 200

SERVICE MANUAL

B|BRAUN
SHARING EXPERTISE

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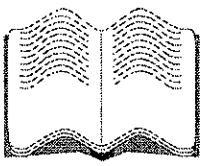
CHAPTER 1.0
INTRODUCTION



IN THIS CHAPTER YOU WILL LEARN:

- The intended use of this service manual.
- About the important features of the Outlook pumps.
- What is covered under the B. Braun warranty.
- Of warnings, cautions, and disclaimers related to the use of this manual.
- How to contact B. Braun Customer Service and Technical Support.

1.1 INTENDED USE

This manual is intended to be used by qualified biomedical service professionals and B. Braun Medical Inc. trained service personnel for the troubleshooting, repair, and maintenance of the Outlook Infusion Pumps. Repair of the pumps should be performed by a qualified biomedical service professional. Although it is not mandatory each service professional be certified by B. Braun Medical Inc. prior to servicing the Outlook pumps, it is recommended and will be made available to your institution upon the expiration of the pump warranty. Please contact Customer Service for additional information on offered training classes and their associated fees. B. Braun Medical Inc. maintains the right to withhold the purchase of parts until a service professional has been certified by B. Braun Medical Inc.

NOTE: This manual contains information and data proprietary to B. Braun Medical Inc. This information is provided solely for technical personnel in maintaining and servicing the Outlook pumps. None of the information contained herein may be duplicated or used in any manner other than for the maintenance and servicing of the pumps or their component parts. Any unauthorized use of the information contained herein may subject the user to substantial liability for infringement of trade secrets, copyright, and patents.

1.1.1 Keys, Text Display, Indicators, and Softkeys

Certain conventions are used within this manual when referring to the pump's keys, LCD text display, indicators, and softkeys.

1.1.1.1 Keys

Keys found on the pump's key panel will be graphically depicted within the

instruction text. For example, the pump's power key will appear as (POWER).

1.1.1.2 Text Display

When referring to informational text or menu items displayed on the pump's Information Screen, the text will appear in the following format: "Tot Infused= 10.7 ml" "DOSE Mode"

When referring to a specific field, the text will appear in the following format: "...highlight the CONC field."

1.1.1.3 Indicators

All Indicators located on the top left of the door are referred to by what they indicate: AC Power Indicator, Battery Indicator, Hold Indicator, Run Indicator, and Alarm Indicator.

1.1.1.4 Softkeys

In some screens there are softkeys which allow the user to access additional functions and/or information. Softkeys available on the Information Screen will appear as follows: "Clear Drug"

Additionally, throughout this manual are icons which identify supplemental information.

ATTENTION: This icon will provide additional information for a given topic in this manual.

NOTE: This icon will provide additional information for a given topic in this manual.

CAUTIONS or WARNINGS: This icon will provide safety recommendations in order to prevent accident or injury to the user or the patient.

1.1.1.5 Companion Documents

The following documents are companion documents to this Service Manual and will be required for a full understanding of the pump's functionality.

- Outlook 200 Operator's Manual - Part No. 950980
- Outlook Windock Operation Manual - Part No. 951031

1.2 IMPORTANT PUMP FEATURES

The Outlook 200 is a Class 1-Internally powered, Type CF, IPX1 drip-proof infusion pump intended for continuous operation. Operation is not suitable in the presence of a flammable anesthetic. Additional features include:

- Flash EEPROMs
- Integrated bar code Scanner (Outlook 200)
- Hand-held bar code Scanner (Outlook 200)
- Daisy Chaining Power Cords
- Easily accessed Main Battery
- Time and date stamped Operation and Alarm Logs
- Subassembly Repair

1.3 PUMP SAFETY

1.3.1 Warnings

WARNING: If the product is partially or completely disassembled, or a component or assembly has been replaced or repaired, the unit must undergo and pass all performance checks outlined in the Performance Check chapter of this manual prior to use for patient care. All final performance testing and calibration of the Outlook pump must be performed with a set that is acceptable for patient use with an exception for set sterility only. Failure to do so may cause bodily harm and will void all warranties and liabilities.

WARNING: Rework of multi-layer boards should not be attempted unless personnel have attended and passed an accredited course in soldering techniques for this type of board and express written consent has been obtained from an authorized B. Braun Service Center Representative. Failure to do so will void all warranties.

WARNING: B. Braun will assume no responsibility for incidents which may occur if the product is not used in accordance with product labeling.

WARNING: Always read and follow the instructions which accompany the source container and IV administration sets you are using. Carefully follow the instructions for loading, removing and reloading the set, as well as the recommended set change intervals.

WARNING: To avoid mechanical or electronic damage, do not steam autoclave or immerse the pump in any fluids or cleaning solutions. Always disconnect the power cord from the outlet or from other Outlook pumps before cleaning to prevent electrical shock.

WARNING: Trained Biomedical professionals or B. Braun representatives must perform a full set-up of the pump before use in a clinical setting to ensure proper programming and function of device.

WARNING: If the pump has been dropped or appears to be damaged, immediately remove the pump from service. A qualified Biomedical professional should inspect the device.

WARNING: Prior to starting an infusion, verify no drops are falling in the drip chamber and the programmed information is correct. If drops are falling and the infusion has not begun, the set may be improperly loaded and further use may result in inaccurate infusion.

1.3.2 Cautions

CAUTION: The Outlook 200 is a class 2 laser product according to IEC 60825-1 standard. LASER RADIATION - Do Not Stare Into Beam

CAUTION: The pump may have been damaged during shipping and handling. Do not use the pump if it appears damaged or fails the initial self test as patient injury or device damage may occur.

CAUTION: The power cord must be connected to a 110-120 VAC, 50/60 Hz grounded 3-prong receptacle designated as "Hospital Grade."

CAUTION: Wear a grounding wrist strap when assembling or disassembling the pump. Do not lay pump face down on components or tools which could scratch or damage the LCD or key panel.

CAUTION: It is not recommended to Daisy Chain more than five Outlook pumps together.

CAUTION: Do not use in the presence of flammable anesthetics, as a possible explosion hazard exists.

CAUTION: Do not clean, disinfect, or sterilize any part of the device by autoclaving or with ethylene oxide gas. Doing so may damage the device and void the warranty. Only external parts of the pump should be disinfected.

CAUTION: When attaching this pump to a pole, make sure it is clamped securely to avoid damage to the device.

CAUTION: As with all medical electronic equipment, care must be taken to avoid exposure to powerful sources of electromagnetic interference and strong magnetic fields such as Magnetic Resonance Imaging (MRI). Permanent damage may result.

CAUTION: Perform testing and/or preventive maintenance as defined in this Service Manual or the reliability and proper functionality of the unit cannot be assured.

CAUTION: Individual component replacement is not recommended and will void any and all warranties unless express written consent has been obtained from an authorized B. Braun Service Center Representative. B. Braun recommends board replacement as it may not be possible to test complete circuit function to factory specifications.

1.3.3 Attentions

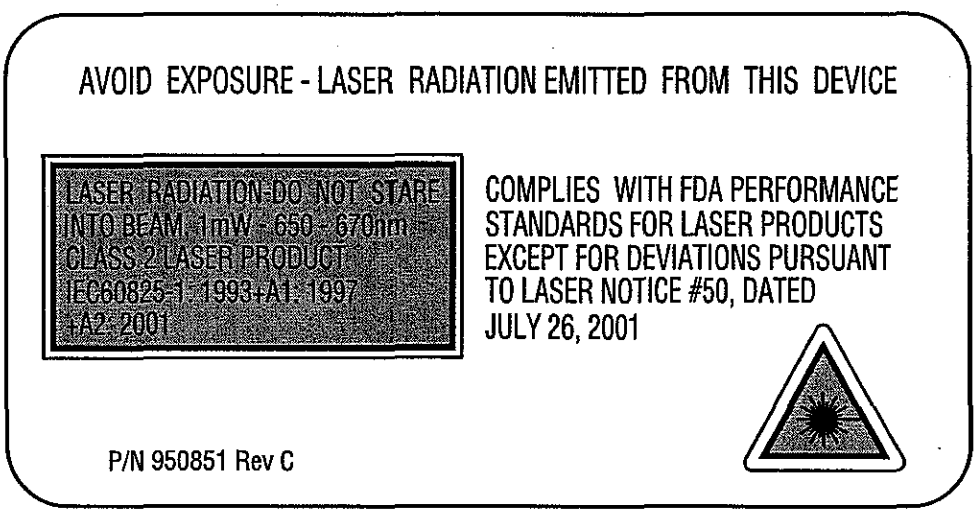
ATTENTION: Medical Equipment, with respect to Electrical Shock, Fire and Mechanical Hazards only in accordance with UL2601-1, CAN/ CSA C22.2 No. 601.1.

ATTENTION: The DB9 connector on the back of the Outlook pump is for use by authorized personnel only.

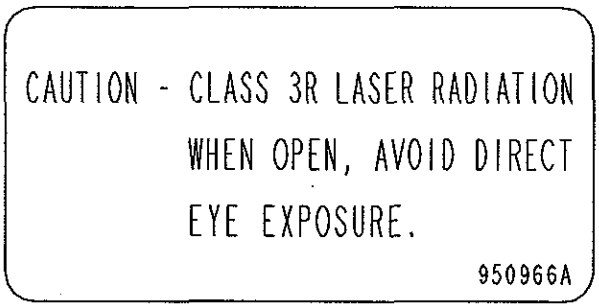
ATTENTION: Only use a B. Braun specified lithium replacement battery!

1.3.4 Laser Caution Labels

The following laser caution label (enlarged to show detail) is affixed to the handle of the device.



The following laser caution label is affixed to the bottom of the device.



1.3.5 Disclaimers

Due to the criticality of product performance, B. Braun recommends that all required service on the Outlook pump be performed only by an authorized B. Braun Service Center or a qualified biomedical repair professional who has attended the B. Braun service training course. Repairs should not be attempted without a current Service Manual. Repairs should not be attempted by other than qualified personnel that are knowledgeable in the areas of microprocessor controlled electronics, digital and analog circuitry, electromechanical devices, testing, static control and soldering techniques. Repairs should not be attempted which have not specifically been identified in this Service Manual.

By performing any repairs with or without use of this manual as reference, you hereby acknowledge and agree that B. Braun and its distributors shall be indemnified and held harmless from and against any and all damages, liabilities, actions or causes of action, including attorney's fees, directly or indirectly arising out of or resulting from such repairs.

You also understand that neither B. Braun nor its distributors shall be liable for any incidental or consequential loss, damage, or expense directly or indirectly arising from authorized or unauthorized repair of this device since the quality of repair, and the knowledge and experience of personnel performing repairs, as well as other factors relating to matters beyond B. Braun's control, directly affect the device and the results obtained from its use.

B. Braun neither assumes, nor authorizes any other person to assume for it, any other or additional liability or responsibility in connection with repair of this device. B. Braun accepts no financial obligations for any institution's authorized or unauthorized repair during the warranty period. The information contained in this manual is current as of the date of issue.

1.4 SERVICE & TECHNICAL SUPPORT

1.4.1 Contact Information

If the pump fails to respond to the operating or troubleshooting procedures listed in this manual, and the cause cannot be determined, discontinue using the pump.

Service and product performance information may be obtained from the manufacturer by contacting:

B. Braun Medical Inc.
1601 Wallace Drive, Suite 150
Carrollton, Texas 75006
Attn.: Manager of Service
(800) 627-7867

Product complaints may be sent to the Customer Complaints Supervisor at the above address.

1.4.2 Pump Returns

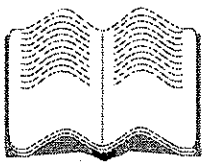
Should it be necessary to return the pump to the manufacturer, carefully pack the pump, preferably in the original packing, and ship it prepaid to the above address. The manufacturer cannot assume any responsibility for loss or damage to returned instruments while they are in transit.

Authorization to return products must be received from B. Braun prior to shipment. Please contact Customer Service at the above phone number for a Returned Materials Authorization Number.

With each question or complaint, please include:

- the pump's serial number (located on the rear of the pump),
- a description of the difficulty experienced,
- the pressure limit setting,
- the rate setting,
- the initial volume(s) to be infused,
- the type of fluid(s),
- the amount of time between the start of the infusion and the time the difficulty was noticed,
- the message displayed at the time the difficulty occurred,
- the diagnostic code number (if applicable),
- the catalog and lot number of the set(s) in use, and
- any other information which might aid in the investigation of the complaint.

CHAPTER 2.0
PUMP DESCRIPTION



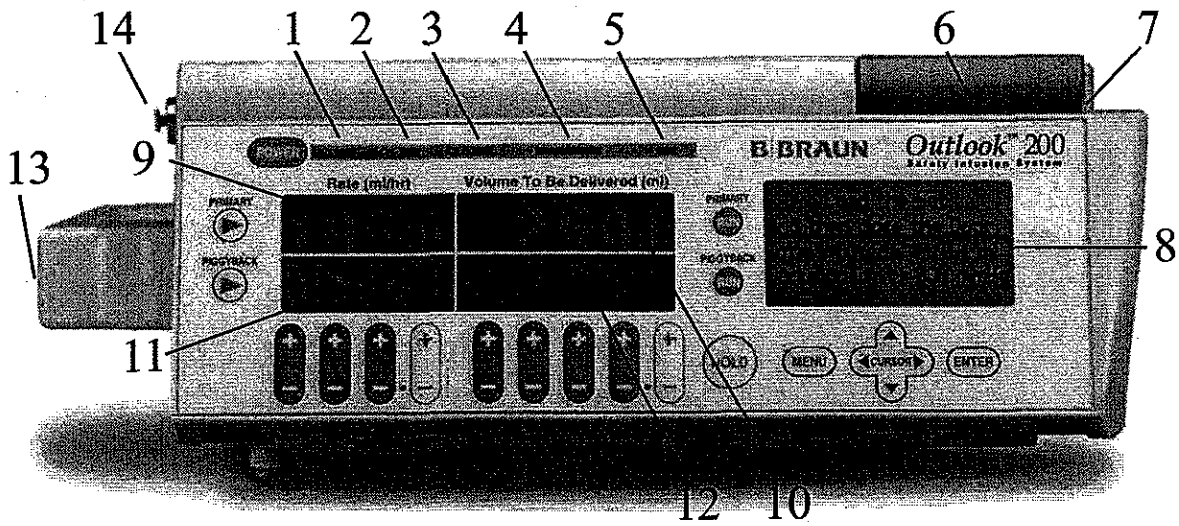
IN THIS CHAPTER YOU WILL LEARN:

- The visual indicators and pump controls.
- Of the location and function of the key panel keys.
- The pump's technical specifications.

2.1 VISUAL INDICATORS & CONTROLS

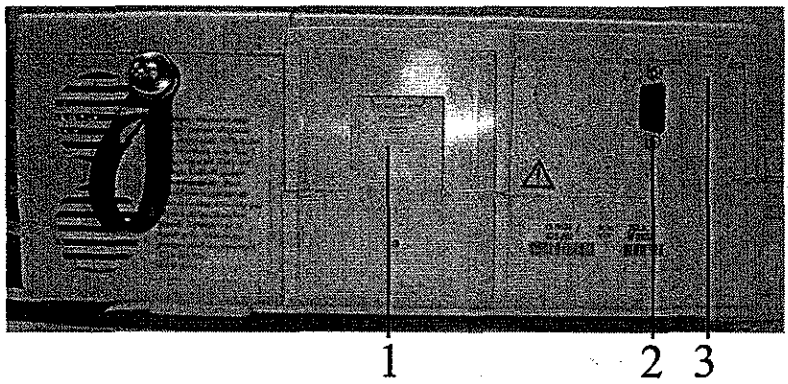
2.1.1 Front View

1. AC power indicator
2. Battery Indicator
3. Hold Indicator
4. Run Indicators
5. Alarm Indicator
6. Door Lever
7. Pole Clamp
8. Information Display
9. Primary Rate Display
10. Primary Volume To Be Delivered Display
11. Piggyback Rate Display
12. Piggyback Volume To Be Delivered Display
13. DoseScan™ Label Scanner Aperture
14. Receptacle for optional hand-held Scanner



2.1.2 Back View

1. Daisy Chain Outlet Access Door
2. Communication Data Port
3. Panel Lock Out Switch



CAUTION: Although a DB9 port, the Communication Data Port is NOT a PC communications port and should not be connected to any other device other than directed in applicable B.Braun documentation.

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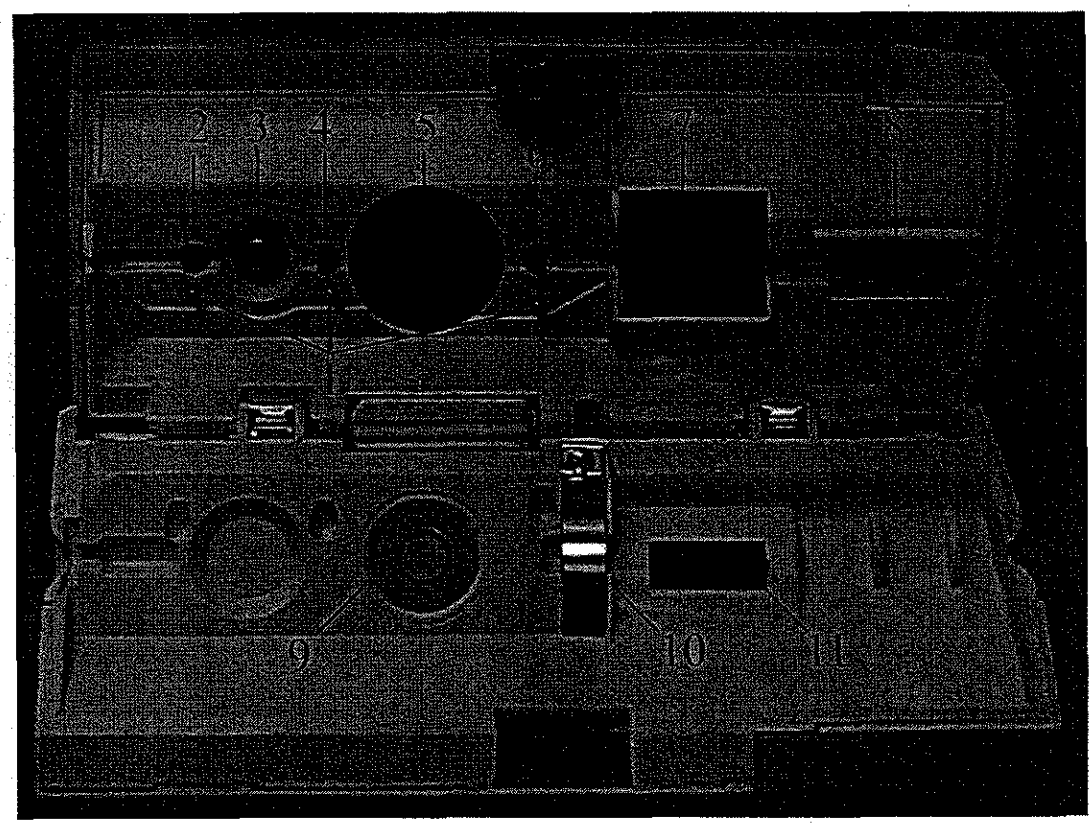
2.1.3 Inside Door View

1. Cassette Alignment Pins
2. Inlet Valve
3. Refill Piston
4. Transfer Valve
5. Petal Module Cover
6. Restriction / Outlet Valve
7. Air-In-Line Detector
8. Free Flow Protection Clip Receptacle
9. Pressure Transducer
10. Free Flow Prevention Spring
11. Tube Pusher



2.2 KEY PANEL

1. **POWER** turns the pump on and off.

2. **RUN** keys begin the infusion of either the Primary or Piggyback channels.

3. **Channel Indicator** keys select either the Primary or Piggyback channels for data entry.

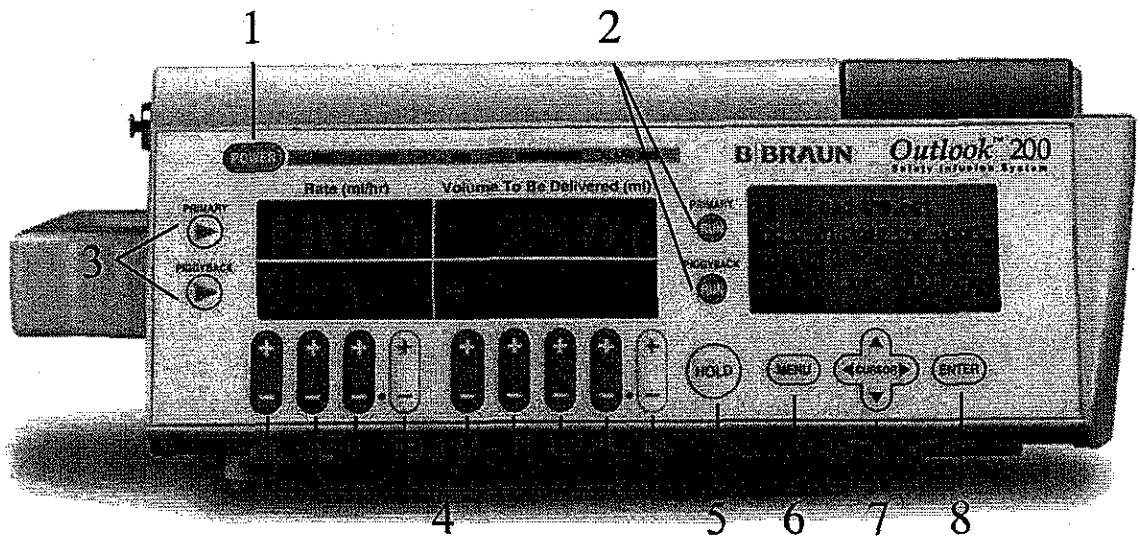
4. **DATA** keys allow input of numbers.

5. **HOLD** silences an alarm, stops an infusion,is a quick escape from the menu, and extends the Stop state an additional 3 minutes every time it is pushed.

6. **MENU** lets the user see other modes and options.

7. **CURSOR** keys move the cursor on the Information Screen.

8. **ENTER** accepts data or the selection made.



2.3 TECHNICAL SPECIFICATIONS

Catalog Number Outlook 200	620-200
Type of Unit	Volumetric (Non Drop-Counting), Positive Pressure Displacement Reservoir
Classification	Class 1-Internally Powered, CF type, IPX1 drip-proof, not suitable in the presence of flammable anesthetic and intended for continuous use in accordance with UL2601-1.
Dimensions	Width =12", Height=4.5", Depth=8.75"
Weight	approx. 11 lbs
Power Requirements	120 VAC, 2A, 60 Hz excluding accessories (domestic)
Electrical Shock Protection	Type CF shock protection in accordance with UL2601-1.
EMI/EMC Compliance	Meets or exceeds EN60601-1-2:2001 for Class B, emissions and immunities standard.
Ground Impedance	Less than 0.2 ohms (tested per UL2601-1)
Grounding Resistance	Meets UL Standard 2601
Leakage Current	Meets or exceeds UL Standard 2601
Plug	Hospital Grade (3 pin)
Pole Size Range	0.85"-1.3"
Batteries	• 12 Volt sealed lead-acid battery for portable use. Run time is dependent on the state of battery charge and the rate of fluid delivery • 3 Volt lithium battery for RAM data retention • 4.8 Volt NiCAD battery for backup alarm
Delivery Rate Range	0.1 to 999.9 ml/hr, in 0.1 ml/hr increments Micro Mode: 0.1 to 99.9 ml/hr
Volume to be Delivered Range	0.1 to 9999.9 ml, in 0.1 ml increments
Occlusion Limit Settings	75, 100, 200, 300, 400, 500 and 750 mmHg. Standard default is 300 mmHg.
Keep Vein Open Rate	3.0 ml/hr or selected rate, whichever is lower
Volume Delivered Accuracy	± 5%

Fluid Types	All standard IV fluids
Alarms	Air-In-Line, Battery Very Low, Close Roller Clamp, Container Empty, Downstream Occlusion, Door Open, Hold Time Exceeded, KVO, Low Battery Warning, System Error.

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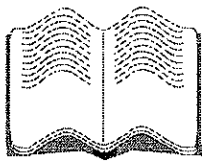
CHAPTER 3.0
RECEIVING PROCEDURE



IN THIS CHAPTER YOU WILL LEARN:

- How to properly receive in an Outlook pump.
- How to perform a receiving inspection.
- What procedures to follow when checking in a pump.

3.1 INTRODUCTION

3.1.1 Notices

Any new device that does not meet factory specifications during incoming inspection will be replaced only if the device is not altered, i.e. hospital identification markings, asset control numbers, or preventative maintenance tags. If a device is used on a patient, it will not be considered an out-of-box failure.

3.1.2 Damaged Goods

Upon receipt, count and inspect your freight before the carrier departs. Damaged merchandise should not be accepted. Identify any items that are damaged or lost, and have the extent of the damage or loss noted on the customer's copy of the delivery document by an agent of the transportation company. If damage is discovered after receipt of shipment, notify the transportation company immediately, and request that inspection be made and an inspection report rendered. B. Braun will be happy to issue a credit for the loss or damage, and file a claim with the carrier, providing your request and the carrier's freight bill indicating the item and quantity damaged or not received are promptly forwarded to the Service Center (refer to 1.4.1) and received within ten days. The claim request must be accompanied by a delivery receipt or an inspection report upon which the transportation company has properly noted such damage or loss.

3.1.3 Receiving Errors

Items ordered or shipped in error may be returned to the warehouse provided Customer Service is notified (refer to 1.4), and the products are returned within 14 days. Items ordered in error must be returned freight prepaid by the customer.

Credit will be issued for all returns for goods received in error provided:

- Proper authorization has been obtained (refer to 1.4.2).
- Products are in the original undamaged cases, suitable for immediate resale.
- Products are current inventory items.

- Merchandise has been shipped and billed to the customer by B. Braun.

Certain products are not eligible for return for credit. These are:

- Products which have been used.
- Products whose labels or seals have been tampered with or removed.

Except in the case of a B. Braun error, items must be returned freight prepaid by the customer.

3.1.4 Late Shipments

B. Braun shall be excused from any delay in, or impossibility of performance due to any cause beyond its or its suppliers' or subcontractors' control, including, but not limited to: acts of God, war, acts of government, acts of purchase priorities or allocations, raw material shortages, fire, flood, strike, labor trouble, sabotage or delay in obtaining labor, materials, equipment, or transportation.

3.1.5 Expedited Shipments

When expedited transportation, specialized services, or alternate transportation modes are specified by the customer, an additional charge to cover the premium expense will be added to the invoice.

3.2 RECEIVING INSPECTION

Each Outlook pump is factory inspected and tested prior to its final packaging and shipment. There is, however, the possibility of in-transit damage which may or may not be obvious; therefore, the following inspection is recommended.

1. Before opening the shipping container, inspect it carefully to assure the absence of obvious damage. If damage is present, notify the freight carrier immediately, and wait to open the container until a representative of the shipping company is present. (It is difficult to place responsibility for shipping damage after the shipping container is opened). Do not return damaged equipment to B. Braun unless specifically authorized to do so by Customer Service, whether or not B. Braun is responsible for the repair.
2. Carefully remove the pump from the shipping carton. Retain the packaging materials in case the pump ever has to be shipped for repair.
3. Remove the plastic cover(s) on the Rate Displays and Information Screen; make sure there are no visible dents, tears or scratches on the pump displays or key panel.
4. Complete Section 6.2 of the Performance Check outlined in Chapter 6.0.

3.3 CHECK-IN PROCEDURE

Prior to use, it is recommended that the pump be checked-in according to the procedures indicated in this Manual. If the pump fails to operate, contact B. Braun for a Returned Materials Authorization Number (refer to 1.4.2.)

Each pump has been inspected and tested prior to shipment; however, in-transit handling or repair work may have caused some misalignment. Therefore, the procedures referenced in this manual are intended to be used by qualified service personnel in the initial and routine checks of the Outlook pumps.

3.3.1 Main Battery Check and Charging

All rechargeable batteries automatically discharge when not in use. The rechargeable battery used in this pump is no exception. Therefore, it is suggested that before attempting to use the pump for the first time, the battery be fully charged by connecting the power cord of the pump to a hospital grade electrical outlet for at least 24 hours.

In order to maintain the battery in a fully charged condition, the pump should be plugged into a hospital grade electrical outlet whenever possible. When charging multiple devices in a storage facility, ***not in the vicinity of patients***, up to 5 Outlook pumps may be Daisy Chained together for outlet conservation purposes.

3.3.2 Performance Check

Prior to patient use, every new pump must pass the entire Performance Check outlined in Chapter 6.0.

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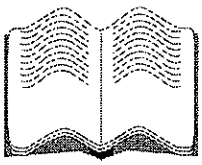
CHAPTER 4.0
PUMP CONFIGURATION



IN THIS CHAPTER YOU WILL LEARN:

- How to enter the Biomed Options Menu of the pump.
- How to customize the pump software.
- How to set up the Drug Lists in DOSE Mode.

4.1 ENTERING THE BIOMED OPTIONS MENU ON THE PUMP

1. Press (POWER) for two seconds.
2. Press (MENU).
3. Use the (CURSOR) to highlight "Alternate Menu," then press (ENTER).
4. Use the (CURSOR) to highlight "Biomed Options," then press (ENTER).

Please enter 4-digit security code, such as 1342 and Press ENTER

5. Use the (+ -) (data) keys to enter the Security Code.

The Security Code is not really a number, but a key press sequence. For example, to enter the Security Code "1342," press the "+" on the thousands key once, then the ones key once, then the hundreds key once, then the tens key once, then press (ENTER).

The Security Code number is created randomly each time the screen is shown.

4.2 CONFIGURATION

The Outlook pump can be customized to fit the specific needs of each facility. The Outlook's Biomed Options Menu contains the configuration options for the user interface. A variety of options may be placed in either the Main or Alternate Menus, or the option may be disabled. Your B. Braun Sales Representative can provide you with a Programming Worksheet for the pump which details where the menu items may be placed within the menu system, along with the other settings which may be customized. This Programming Worksheet should be completed by representatives from the Medical, Nursing, and Pharmacy staff.

According to the facility wishes expressed on the Programming Worksheet, the Biomedical Professional first creates a "Golden Pump" with all modes and options placed in the appropriate menus, as well as data retention defaults, drug selections, concentrations, and audible and pressure defaults. Outlook WinDock then allows a configuration file to be made from this "Golden Pump" which can be downloaded to the next pump, expediting the process of configuring multiple pumps.

To access the following features, enter the Biomed Options Menu (refer to 4.1).

4.2.1 Forcing Factory Defaults

NOTE: It is important to "Force All Defaults" before configuring a pump in order to avoid corrupted data.

1. Use the CURSOR to highlight "Load Factory Defaults," then press ENTER.
2. Use the CURSOR to highlight "YES," then press ENTER.
3. Press POWER.
4. Press and hold POWER to turn on the pump.
5. Enter the Biomed Options Menu.

4.2.2 Configuring Menus

1. Use the CURSOR to highlight "Configure Menus," then press ENTER.
2. Press ENTER again. A list of modes and pump features appears.
3. Use the up and down CURSOR to move through the list.

4. Press the right and left CURSOR to select the appropriate choice of Main Menu (MAIN), Alternate Menu (ALT), or Disabled (DIS).
5. When finished, press ENTER to return to the Biomed Menu.

4.2.3 Default Occlusion Limit

NOTE: The Factory Default value for the Occlusion Limit is 300 mmHg.

1. Use the CURSOR to highlight To select "Retain Last Setting,", then press ENTER.
2. To select a specific Fixed Value as the Default Occlusion Limit, use the CURSOR to highlight "Fixed Value=300 mmHg," and use the + - keys to change the Occlusion Limit to 75, 100, 200, 300, 400, or 500 mmHg.
3. When finished, press ENTER to return to the Biomed Menu.

4.2.4 Data Retention Defaults

1. Use the CURSOR to highlight "Data Retention Defaults," then press ENTER.
2. Use the CURSOR to highlight either "Clear All" or "Retain All."
3. When finished, press ENTER to return to the Biomed Menu.

4.2.5 Audible Signal Options

1. Use the CURSOR to highlight "Audible Signal Options," then press ENTER. A list of audible pump options appears.
2. Use the up and down CURSOR to move through the list.
3. Press the right and left CURSOR to select "Y" (Yes) or "N" (No) to enable or disable an option.

4. When finished, press ENTER to return to the Biomed Menu.

4.2.6 Review Time & Date

1. Use the CURSOR to highlight "Review Time & Date."
2. Use the CURSOR to highlight the time or date field requiring change.
3. Use the + - keys to change the data.
4. When finished, press ENTER to return to the Biomed Menu.

4.2.7 Setup Drugs

1. Use the CURSOR to highlight "Setup Drugs," then press ENTER.
2. Use the CURSOR to highlight a Drug List under which drugs/concentrations will be assigned, then press ENTER. An alphabetical listing of drugs appears.
3. Press the up and down CURSOR to highlight the drug to be placed in this Drug List.
4. Use the left CURSOR to select "Y" (Yes), then press ENTER.
5. Enter up to two different concentration values, as they appear on the Worksheet, using the + - (data) keys.

NOTE: In order to change the units associated with the concentration, use the right CURSOR to highlight the units field. Use the up and down CURSOR to toggle through the unit choices.

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6. Enter the DoseGuard™ MIN and MAX values as they appear on the Worksheet, using the  (data) keys.

NOTE: The Maximum DoseGuard value must be equal to or greater than the Minimum DoseGuard value.

7. Press (ENTER) when done entering the concentration and DoseGuard information for that drug.
8. Repeat steps 3 through 7 until all of the drugs on the Worksheet are configured for that Drug List.

NOTE: The (MENU) key will act as a Page Down key while in a Drug List.

9. Use the  to highlight "Save List" at the bottom of the drug list, then press (ENTER).
10. Repeat steps 2 through 9 until all Drug Lists are configured.
11. Use the  to highlight "Exit," then press (ENTER) to return to the Biomed Menu.

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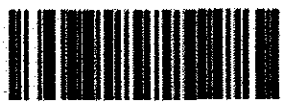
4.2.8 Hand-Held Scanner Setup for Standard Bar Coding

The handheld scanner may require programming before being used for standard bar coding applications. The following 3-step procedure describes how to program it for the application.

NOTE: If you make a mistake, or lose your place while setting an option, scan the END label to exit Programming Mode. The scanner will sound an error tone (six rapid beeps) to indicate that programming was incomplete, and the setting will remain as it was before entering Programming Mode.

NOTE: The following procedures require the DoseScan™ option to be selected from the Main Menu to enable the hand-held scanner.

1. Set the Prefix
   - Scan the SET label.

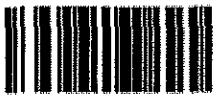


SET Label

   - Scan the SET PREFIX label.

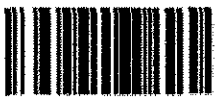
SET PREFIX Label

- Scan 2, 5, 2, F digit labels for the prefix characters '%' and '/'.



2 Label

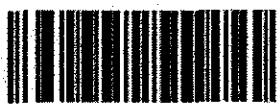
5 Label



2 Label

F Label

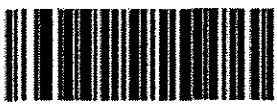
- Scan the END label.



END Label

2. Set the Suffix

- Scan the SET label.

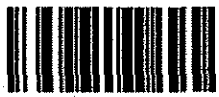


SET Label

- Scan the SET SUFFIX label.

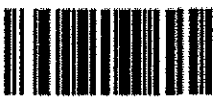
SET SUFFIX Label

- Scan 2, F, 2, 4 digit labels for the prefix characters '/' and '$'.



2 Label

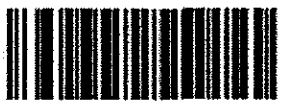
F Label



2 Label

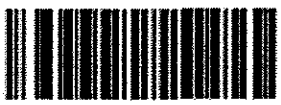
4 Label

- Scan the END label.



END Label

3. Disable label I.D. control
   - Scan the SET label.

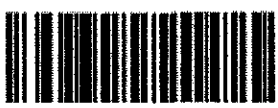


SET Label

   - Scan the Disable Label I.D. Control label.

Disable ID Label

   - Scan the END label.



END Label

4.2.8.1 Optional Settings for the Hand-Held Scanner

It may be desirable to turn off the scanner power-up beep and set the beeper volume to low, or return to factory settings.

To Turn off Power-up Beep:

- Scan the SET label.

SET Label

- Scan the Power-up Beep Disable label.

Beep Disable Label

- Scan the END label.

End Label

To Set Beeper Volume to Low:

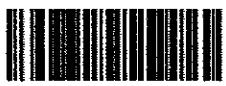
- Scan the SET label.

SET Label

- Scan the Beeper Volume Normal label.

Beep Normal Label

- Scan the END label.



End Label

CAUTION: use the Factory Default label with caution, as it will disable ALL options that may have been programmed since the scanner's installation.

To return the Hand-Held Scanner to factory settings:

- Scan the Factory Default label.

Factory Default Label

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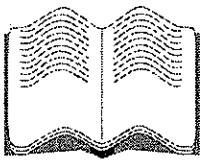
CHAPTER 5.0
CLEANING & PREVENTATIVE MAINTENANCE SCHEDULE



IN THIS CHAPTER YOU WILL LEARN:

- Recommended cleaning solutions and procedures.
- About the recommended preventative maintenance schedule.

5.1 CLEANING

Clean the pump with a swab or soft, lint-free cloth dampened (not saturated) with any of the following recommended solutions:

- Household Bleach and 90% Water
- Isopropyl Alcohol
- Warm Soapy Water

DO NOT allow fluids to enter the pump during cleaning and disinfecting. It is preferred to maintain the device in an upright position when cleaning.

DO NOT use acetone solutions containing glutaraldehyde, ammonium chlorides, or abrasive cleansers on the pump. They may scratch the surface and degrade the plastic.

Once the infusion pump is cleaned, **wipe the entire pump twice with fresh water** using a soft, lint-free cloth to remove all remaining cleaner/disinfectant. Then thoroughly dry the instrument with a soft, lint-free cloth. Inspect the device to ensure all fluid is removed.

Refer to the hospital's housekeeping, central service, or infection control department for policies and procedures for cleaning biomedical equipment of this nature.

WARNING: To avoid electrical shock, turn the pump off and disconnect it from the electrical outlet before cleaning.

WARNING: To avoid electrical shock, insure the AC power connector is clean and dried thoroughly prior to connecting the power cord.

CAUTION: To avoid mechanical or electronic damage, DO NOT steam autoclave or immerse the pump in any fluids or cleaning solutions.

CAUTION: Sterilization of the pump using ethylene oxide (EtO) gas or Autoclaving is not recommended.

CAUTION: Do not clean the pump using high pressure devices.

5.2 PREVENTATIVE MAINTENANCE SCHEDULE

The Outlook pumps should be maintained according to the following schedule:

After Every Use
• Clean exterior and inside door as recommended above.
• Check pump labels; ensure they are affixed securely and legible.
• Verify there are no nicks or cuts in the power cord.
• Check that the pole clamp operates correctly.
• Verify the feet of the pump are intact, secure and free of cuts or damage.
• Recharge the battery in-between patient uses and while in storage.

Every Month
• Fully recharge the battery by allowing it to charge for 24 hours.

Once Every 6 Months
• Complete all checks for "After Every Use" above.
• Replace Petal Module Cover (refer to Section 9.14)

• Complete the following Performance Check as outlined in Chapter 6.0.
  • Mechanical Inspection (refer to Section 6.2)
  • Simulated Use Test (refer to Section 6.3)
  • Volume Delivery Accuracy Test (refer to Section 6.4)
  • Electrical Safety Test (refer to Section 6.8)
  • Main Battery Capacity Test (Optional) (refer to Section 6.10)

Once Every 12 Months
• Complete all checks for "After Every Use" above.
• Complete all checks for "Once Every 6 Months" above.
• Complete the Annual Preventative Maintenance (refer to Section 6.14).

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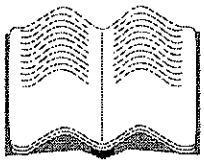
CHAPTER 6.0
PERFORMANCE CHECK



IN THIS CHAPTER YOU WILL LEARN:

- What equipment is required to complete this check.
- How to perform a mechanical inspection of the pump.
- How to perform simulated use, volume delivery accuracy, air-in-line, occlusion pressure, free flow, and electrical safety, power switch over, and main battery capacity tests.
- How to perform pressure transducer a/d offset, restriction/outlet valve yoke adjustment, and inlet solenoid adjustment tests.
- The required Annual Preventative Maintenance procedures.

Portions of this Performance Check should be completed upon initial receipt of the pump (refer to 3.2 & 3.3) and as part of a scheduled preventative maintenance program (refer to 5.2). Additionally, all or part of this Performance Check should be completed after repairs have been made. At the end of each repair procedure, you will be directed as to which part of this Performance Check must be completed.

WARNING: Do not perform these procedures while the Outlook is in patient vicinity or while in patient use. Failure to comply could result in bodily harm.

WARNING: If the product is partially or completely disassembled, or a component or assembly has been replaced or repaired, the unit must undergo and pass all performance checks outlined in Chapter 6 of this manual and the appropriate calibrations and or tests outlined in Section 6.8 prior to use for patient care. All final performance testing and calibration of the Outlook must be performed with a set that is acceptable for patient use with an exception for set sterility only. Failure to do so may cause bodily harm and will void all warranties and liabilities.

CAUTION: Continuous deep discharge of the battery may cause damage to battery cells and lead to premature battery replacement.

WARNING: Shock Hazard. Prior to disassembling or performing service on the Outlook Pump, it is recommended that the pump be disconnected from the AC power source unless you feel it is specifically required for a particular test. If you find it necessary to have the device connected to an AC power source, use a line isolation transformer and caution. Failure to do so could result in bodily harm.

WARNING: Shock Hazard. The inside of the Outlook case has a conductive coating which is connected to ground through the power supply module. When servicing the Outlook, use caution to prevent accidental shorting to this coating. Failure to do so may result in component damage or even bodily harm if a line isolation transformer is not used when the AC power supply cord has not been disconnected.

6.1 TEST EQUIPMENT, MATERIALS, AND CONSUMABLES

Below is a suggested list of test equipment, accessories and materials for checkout, calibration and troubleshooting the Outlook pump.

Item	**Size/Model/Description**	**Suggested Brand (or Equivalent)**
IV Pole	Standard	Pryor
IV Administration Sets	Any Horizon® IV Pump Set	B. Braun Medical Inc.
IV Source Container	1 L Sterile Water	B. Braun Medical Inc.
Digital Scale (1 mg accuracy)	100 g capacity	Mettler PC440
Collection Vessel	≥20 ml	
Needle	20 ga., 1 inch or less	Becton Dickinson & Co.
Syringe	1 ml and 10 ml	Becton Dickinson & Co.
Medical Equipment Electronic Safety Analyzer	231 D	Dynatech Nevada Safety/ ECG analyzer
Digital Voltmeter	78	Fluke
Non-metallic feeler gauge	0.008" to 0.016"	
GO-NO/GO Gauge	P/N FZ00402069	B. Braun Medical Inc.
Outlook Biomed Box Kit	P/N FZ501630	B. Braun Medical Inc.

6.2 MECHANICAL INSPECTION

6.2.1 Equipment Required

- IV Pole
- IV Administration Set

6.2.2 Exterior

6.2.2.1 Door Lever

1. Pull the door lever on the right side of the pump forward.
2. Verify the door opens and the lever returns when released.

6.2.2.2 Door Alignment

1. Make sure the door of the pump opens and closes easily, without binding, and that it is properly aligned with the bezel. The door latch allows the door to close completely.
2. Check that the gap on each side and along the top of the door is symmetrical.

6.2.2.3 Pole Clamp

1. Unlock the QuickClamp pole clamp by rotating the lever clockwise (toward the front of the pump).
2. Press down on the lever. Make sure the lever slides up and down the full length within its channel.
3. Press down on the lever and place the V-block of the instrument case against the IV pole.
4. Release the lever, then press lightly on the top of the pump to seat the pole clamp securely.
5. Rotate the lever to the Locked position by rotating it counterclockwise (toward the back of the pump).
6. Verify the pole clamp mechanism attaches the pump securely to the IV pole.

6.2.2.4 Hardware Inspection

1. Check that all screws are tight and secure.
2. Ensure no cracks are present in the bezel or inner door face.
3. Ensure no cracks in the case or handle exist.
4. Check that the Power Cord Management snap tab is attached to the pump back.
5. Inspect the plug for bent or insecure prongs and check the power cord for nicks or cuts.

6. Check that all gaskets and seals are securely attached.
7. Check that the cover on the pressure transducer does not have any rips, tears, punctures or indentation marks.
8. Ensure the tube pusher is intact and securely mounted.

6.2.3 Bezel

6.2.3.1 Petal Module Cover

1. Inspect the petal module cover and valve tips to ensure they are in place and in good condition.

6.2.3.2 Air-In-Line Detector

1. Verify the Air-In-Line Detector Tube Pusher is intact and securely mounted.
2. Ensure the Air-In-Line Detector is clean and securely mounted.

6.2.3.3 Free Flow Protection Clip Receptacle

1. Load the cassette into place on the alignment pins.
2. Place the tubing along the tubing channel and in the Air-In-Line Detector.
3. Place the blue Free Flow Protection Clip in the Receptacle.
4. Close the door of the pump.
5. Open the door of the pump.
6. Gently pull on the Free Flow Protection Clip.
7. Verify the tubing can be removed with the tubing clamped off.

6.2.3.4 Hinges

1. Verify the roller pin on the door latch rolls freely.
2. Close and open the door.
3. Verify the hinges are smooth.

6.2.4 Mechanical User Interface

6.2.4.1 Power Up

1. Press (POWER).
2. Verify the following:
   - the Hold Indicator illuminates then extinguishes,
   - the Primary Volume To Be Delivered display shows 4 "****" symbols,
   - the Information Screen illuminates, and

- the speaker sounds one tone.

3. Verify the AC Indicator illuminates when the pump is plugged into AC power.

6.2.4.2 Information Screen

1. Verify there are no dark spots, blotches, lines or missing/partial text appearing on the Information Screen.

6.2.4.3 Rate Display

1. Verify there are no missing segments and all segments are equally illuminated.

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6.3 SIMULATED USE TEST

6.3.1 Equipment Required

- IV Pole
- AC power source
- Primed IV Administration Set
- IV Source Container

6.3.2 Test Procedure

Action	Observation/Results
1. Attach the pump to the IV pole.	The Pole Clamp mechanism tightens firmly onto the pole.
2. Plug into AC power and press (POWER) to turn on the pump.	The pump powers up as described in "6.2.4.1 Power Up." The Information Screen illuminates and displays: Load the Set and then close the Door. Total Infused = 0.0 ml Occlusion Limit = 300 mmHg Note: If no keys have been pressed for approximately 30 seconds, "Hold" will be displayed in the Primary or Piggyback channel, whichever is not active. If no keys have been pressed for 3 minutes, "Hold" will flash in the Primary VTBD Display and the alarm will sound.
3. Individually press and hold the + and - portion of each (+/-) key to verify operation. Press PIGGYBACK (▷) and repeat. Return the Primary and Piggyback Rate and VTBD values to zero.	Key clicks are heard as the numbers sequence. An audible beep will sound as the hundreds column of the Rate and the thousands column of the VTBD Display are advanced past 9 or if any column is decremented past 0.

Action	Observation/Results
4. Enter a Primary Rate of 120.0 and a Primary VTBD of 5.0. Press Primary (RUN).	The audible alarm begins to sound and repeat approximately once every 5 seconds after. The Alarm Indicator illuminates. The Rate and VTBD Displays read "CHECK SET". The Information Screen displays: CLOSE ROLLER CLAMP Then open door. Check placement of Secure Flow Clamp
5. Press (HOLD).	The Information Screen displays the above message. The Rate and VTBD fields display those values present prior to attempting the initiation of the infusion.
6. Press (MENU). Use the down (CURSOR) to highlight "Set LCD Contrast," then press (ENTER). Note: Depending on the pump configuration, "Adjust Display" may be located in the Alternate Menu.	The Information Screen displays: EXIT Adjust cursor <--- ---> until this message is clear. Then press Enter key.
7. Press the (CURSOR) left and right.	The Information Screen contrast changes from high to low and back to high again when the cursor keys are pressed. The backlight intensity varies with the keypresses and is not erratic and or flickering.
8. Press (ENTER).	The Rate and VTBD fields display those values present prior to adjusting the contrast. The Information Screen displays: Load the Set and then close the Door. Total Infused = 0.0 ml Occlusion Limit = 300 mmHg Flow Clamp Position HELP
9. Load the primed set into the pump according to the instruction label located inside the door. Close the door.	The Rate and VTBD fields display those values present prior to adjusting the contrast. The Information Screen displays: Set the Rate & Volume. Then Press RUN. Total Infused = 0.0 ml Occlusion Limit = 300 mmHg Flow Clamp Position HELP

Action	Observation/Results
10.Enter a Piggyback Rate of 100 and a Piggyback VTBD of 100.0. Press Piggyback (RUN).	During data entry, the Primary Rate and VTBD Displays dim and the Piggyback Rate and VTBD Displays illuminate. During infusion, the Primary Displays extinguishes and the Piggyback Display illuminates the rate and VTBD information. The Run Indicators illuminate sequentially.
11. Press (HOLD). Clear the Piggyback Rate and VTBD Displays back to zero.	The Information Screen displays: Time Left = 0 hr 0 min Total Infused = 0.0 ml Occlusion Limit = 300 mmHg
12. Press Primary (RUN). wait 10 seconds, then open the door.	The Rate Display flashes "Door Open," the Alarm Indicator illuminates, and the alarm sounds. The Information Screen displays: Door Open. To Silence Alarm Press MENU for help, or Press HOLD.
13. Close the door. Press (HOLD).	The alarm silences, the Indicator extinquishes, and the previous infusion information is displayed on the Information Screen with Door Open HELP displayed on the last line.
14. Press Primary (RUN).	At the end of infusion, the pump goes into Keep Vein Open mode at a rate of 3.0 ml/hr with an intermittent 3 tone alarm. The Information screen displays: KVO: Primary Complete Total Infused = 5.0 ml Occlusion Limit = 300 mmHg
15. Press (HOLD). Press (MENU). Use the down (CURSOR) to highlight "DoseScan™" then press (ENTER).	The Information Screen displays: IV Medication Scan Scan Patient ID on Medication Label Exit Verify the bar code reader initiates a scan by the presence of the scanning beam.

16. Press (ENTER).	Observe that the bar code scan is terminated and the scanning beam is extinguished. If (ENTER) is not pressed within approximately 30 seconds after the scan is initiated, the bar code reader will automatically shut off and return the information screen to the Main Menu.
17. Press (POWER) to turn the pump off.	The LED's in the Rate Display display "----" until the device has completed the power down cycle. The AC LED remains lit while the pump is plugged into the AC power supply.

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6.4 VOLUME DELIVERY ACCURACY TEST

6.4.1 Equipment Required

- IV Source Container
- Pump IV Administration Set
- Digital Scale
- Collection Vessel
- 20 ga. Needle

6.4.2 Test Procedure

1. Attach the needle to the delivery end of the set.
2. Spike the Source Container and prime the IV Administration set. Ensure all air is expelled from the set and needle.
3. Position the fluid source so that the fluid head height is 12", ±2" above the inlet portion of the pump.
4. Close the roller clamp on the set.
5. Place the collection vessel on the balance, zero the reading, and suspend the needle over the collection vessel, with the needle no more than 4 inches above or below the center of the pump.
6. Load the set into the pump according to the instructions inside the door of the pump or as indicated in the Operator's Manual.
7. Close the door, plug in the pump, and press (POWER) to turn on the pump.
8. Open all clamps.
9. Enter a Primary Rate of 120 ml/hr, VTBD of 10 ml, and set the Occlusion Limit to 300 mmHg.
10. Press Primary (RUN).
11. When the pump goes into Keep Vein Open mode, press (HOLD) immediately.
12. Verify the actual volume delivered is within the acceptable range of 9.5 -10.5 ml.

NOTE: 1 ml = 1 cc = 1 g of sterile water at room temperature (70° F)

13. Zero the reading on the balance. If the actual value is not within the specifica-

tions, test the pump with additional IV Administration Sets. If the values remain outside the acceptable range, return the pump to an authorized B. Braun Service Center.

NOTE: If using other accuracy test methods, in addition to the above, be sure to compensate for the adaptive energy processing used to conserve battery power and reduce noise as described in section 7.7.7.2 "Motor Controllers." This dynamic processing of resistance to flow will cause the motor energy to rise and fall at the beginning of an infusion (each time the pump transitions from the Hold state to the Run state). This results in several (varies with the system dynamics and rate) momentary pauses of the motor as the energy is changed during the first few delivery cycles after (RUN) is pressed. Manufacturers of biomedical test equipment will supply you with written instructions for use of their equipment when testing IV pumps which employ this type of energy processing. While volumetric analyzers are different, typically all that is required is that you allow 5-10 milliliters of fluid to bleed from the system prior to starting the timer(s) or counter(s). A 3-way stopcock is very useful here. Contact the manufacturer of your volumetric analyzer to ensure proper software and testing procedures are used.

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6.5 AIR-IN-LINE TEST

6.5.1 Equipment Required

- IV Source Container
- Pump IV Administration Set
- 1 ml Syringe
- 20 ga. Needle

6.5.2 Test Procedure

1. Attach the needle to the delivery end of the set.
2. Spike the Source Container and prime the IV Administration set. Ensure all air is expelled from the set.
3. Position the fluid source so that the fluid head height is 12", ± 2" above the inlet portion of the pump.
4. Close the roller clamp on the set.
5. Load the set into the pump according to the instructions inside the door of the pump or as indicated in the Operator's Manual.
6. Close the door, plug in the pump, and press (POWER) to turn on the pump.
7. Open all clamps.
8. Enter a Primary Rate of 900 ml/hr, VTBD of 100 ml, and set the Occlusion Limit to 300 mmHg.
9. Press Primary (RUN).
10. Inject a 0.1 ml air bubble into the "Y" site of the tubing on the upstream side of the pump.
11. When the air bubble reaches the pump, tilt the pump such that the distal (delivery end) is pointing upwards towards the ceiling. This will prevent the air bubble from being captured in the cassette chambers.
12. Verify that when the air bubble reaches the Air-In-Line Detector, the audible alarm sounds, the Alarm Indicator illuminates, the Run Indicators extinguish, the Rate Display displays "Air in Line," and the Information Screen displays:

    Air in Line
    To Silence Alarm
    Press MENU for help, or
    Press HOLD.

13. Press (HOLD)

6.6 OCCLUSION ALARM TEST

6.6.1 Equipment Required

- IV Source Container
- Pump IV Administration Set
- 20 ga. Needle

6.6.2 Test Procedure

1. Attach the needle to the delivery end of the set.
2. Spike the Source Container and prime the IV Administration set. Ensure all air is expelled from the set.
3. Close the roller clamp on the set.
4. Load the set into the pump according to the instructions inside the door of the pump or as indicated in the Operator's Manual.
5. Close the door, plug in the pump, and press (POWER) to turn on the pump.
6. Open all clamps.
7. Enter a Primary Rate of 125 ml/hr, VTBD of 10 ml, and set the Occlusion Limit to 300 mmHg.
8. Press Primary (RUN).
9. Close the clamp downstream from the pump.
10. Verify the audible alarm sounds, the Alarm Indicator illuminates, the Run Indicators extinguish, the Rate Display displays "Occlusion," and the Information Screen displays:

Downstream Occlusion

To Silence Alarm
Press MENU for help, or
Press HOLD.

NOTE: The amount of time will vary depending upon how far downstream the clamp is, the occlusion limit setting, as well as the infusion rate.

NOTE: The Occlusion Limit will automatically increase to High to compensate for the effect of tubing flow resistance as infusion rates exceed 400.0 ml/hr.

11. Press (HOLD), unclamp the downstream tubing, and wait 30 seconds before starting the next step.
12. Enter a Primary Rate of 900 ml/hr, VTBD of 10 ml, and set the Occlusion Limit to 300 mmHg.
13. Press Primary (RUN).
14. Clamp the upstream tubing.
15. Verify the audible alarm sounds, the Alarm Indicator illuminates, the Run Indicators extinguish, the Rate Display displays "Bag Empty," and the Information Screen displays:

Container Is Empty

To Silence Alarm
Press MENU for help, or
Press HOLD.

16. Press (HOLD), unclamp the upstream tubing.

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6.7 STATIC FREE FLOW TEST

6.7.1 Equipment Required

- IV Source Container
- Pump IV Administration Set
- 20 ga. Needle
- Collection Vessel

6.7.2 Test Procedure

1. With the infusion set primed and loaded, turn the pump off
2. With all tubing clamps open and the fluid container as high above the pump as the tubing will allow, verify that no fluid flows out of the set as it hangs straight down from the device.
3. Remove the set from the pump (with clamps still open) and again verify that no fluid flows out of the set.

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6.8 ELECTRICAL SAFETY TEST

6.8.1 Equipment Required

- Medical Equipment Electronic Safety Analyzer

6.8.2 Test Procedure: Electrical Chassis / Case Leakage

NOTE: As of the date this manual was written, the AC leakage current specifications for UL2601-1 is 300 microamps for Class I patient care equipment. When using the Daisy Chain feature on the Outlook (plugging one Outlook into another), the chassis leakage current is cumulative. Therefore, test all units connected as one system. The number of pumps interconnected at any time should not exceed the 300 microamp limit.

1. Plug the analyzer into an AC outlet.
2. Make sure the analyzer is functioning properly, according to your institution's protocol.
3. Plug the pump into the AC outlet of the analyzer.
4. Attach the probe to a single lead and touch it to the metal component of the roller latch.
5. Set the grounding selection to "No Ground."
6. Set the polarity to "Normal."
7. Press the (POWER) to turn on the pump.
8. Press the Chassis Leakage button and make sure the reading does not exceed the UL 2601-1 specifications as indicated in the NOTE: above.
9. Set the polarity to "Reverse."
10. Press the Chassis Leakage button again. Make sure the reading does not exceed the UL 2601-1 specifications.
11. Press (HOLD).
12. Set the polarity to "Off."

6.8.3 Test Procedure: Power Cord Resistance

1. Set the grounding selection switch to "Power Cord Resistance".

NOTE: As of the date this manual was written, the ground wire resistance specification for a device with a non-detachable power cord for UL 2601-1 is 200 milliohms.

2. Attach the probe to a single lead and touch it to the frame around the daisy chain metal component.
3. Verify the reading does not exceed the UL 2601-1 specifications.
4. Disconnect the pump from the analyzer.
5. Disconnect the analyzer from the AC power source.

6.8.4 Test Procedure: Hi-Pot Testing

1. Connect the Hi-Pot tester to an AC outlet.
2. Set the Hi-Pot tester to test 1.5kV for 1 second, or in accordance with your insutution's protocol.
3. Connect the pump's power cable into the Hi-Pot tester or in accordance to the Hi-Pot tester documentation.
4. Press the Test button on the Hi-Pot tester.
5. Verify the pass/fail result in accordance with the Hi-Pot tester criteria.
6. Disconnect the pump from the Hi-Pot tester.

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6.9 POWER SWITCH OVER TEST

6.9.1 Equipment Required

- AC power source

6.9.2 Test Procedure

1. Plug the pump into AC wall outlet.
2. Verify the green AC Indicator illuminates.
3. Access the "Check Battery Level" menu item in the Alternate Menu and verify the battery status indicates either "CHARGING" or "FULLY CHARGED."
4. Unplug the pump from the AC outlet.
5. Verify the Battery Indicator illuminates; status indicates "discharging".
6. Plug the pump into the AC wall outlet again.
7. Verify the AC Indicator illuminates.

6.9.3 Test Procedure: Daisy Chain Power Verification

1. Plug Pump A into AC wall outlet.
2. Plug Pump B's cord into the Daisy Chain Outlet of Pump A.
3. Verify the AC Indicator illuminates on Pump B.
4. Unplug both pumps.
5. Plug Pump B into AC wall outlet.
6. Plug Pump A's cord into the Daisy Chain Outlet of Pump B.
7. Verify the AC Indicator illuminates on Pump A.

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6.10 MAIN BATTERY CAPACITY TEST (OPTIONAL)

It is recommended (but optional) this test be included in the pump's annual PM. B. Braun recommends replacing any batteries older than one year. Due to the length of time required to perform the test, you may wish to test only those devices which are used in an environment that charges the batteries in an erratic and infrequent manner, allowing them to fully charge very rarely; examples of which would be the Operating Room, Emergency Room and Recovery Room. Also included should be those devices which are suspected of having limited battery life.

6.10.1 Equipment Required

- AC power source
- IV Source Container
- Pump IV Administration Set

WARNING: Continuous deep discharge of the battery may cause damage to battery cells and lead to premature battery replacement.

6.10.2 Test Procedure

1. Charge the batteries by connecting the pump to AC power.
2. Allow the batteries to charge continuously for at least 24 hours. The pump can be infusing during this time since the rate of charge is independent of the infusion process.
3. Once fully charged, set the pump to infuse at 125 ml/hr, a volume to be delivered of 500 ml, and a 300 mmHg occlusion pressure limit setting.
4. Begin the infusion.
5. In approximately 3 hours, verify that the "PLUG AC" warning flashes on the unused channel rate LEDs and a tone with increasing frequency, but no more frequent than approximately once every 5 seconds, activates prior to the infusion stopping.
6. Allow the pump to infuse until it stops infusing completely.

NOTE: Total battery operational run time is dependent on factors such as age, routine charging maintenance, and rate of infusion. It is recommended that the main battery be replaced at least every 12 months.

NOTE: Sealed lead-acid batteries can occasionally be "rejuvenated" by a full discharge/charge cycle. For example, if the previously described test results in a less than two hour infusion, then recharge the battery and test again. On occasion, the results can double. This assumes the battery is undamaged.

NOTE: When the pump is first powered up after having infused until the emergency backup alarm activates, a "System Error" message will be generated. This is normal and desirable since the pump recognized that a power down occurred without (POWER) being pressed. Simply turn the pump off then on again to clear the alarm. This event will be stored in the internal logs as alarm code number 123.

Prior to patient use, allow the pump to charge at least 24-hours or until the "Check Battery Level" feature in the Alternate Menu indicates "FULLY CHARGED." A "FULLY CHARGED" message indicates the battery is at least 95% charged.

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The following tests/procedures are required only after device repair or as specified in the Preventative Maintenance Schedule. They are not required for regular Performance Checks.

6.11 PRESSURE TRANSDUCER A/D OFFSET TEST (OCCLUSION VERIFICATION)

6.11.1 Equipment Required

- IV Source Container
- Pump IV Administration Set
- Digital Voltmeter

6.11.2 Test Procedure

1. Spike the Source Container and prime the IV Administration set. Ensure all air is expelled from the set.
2. Close the roller clamp on the set.
3. Load the set into the pump according to the instructions inside the door of the pump or as indicated in the Operator's Manual.
4. Enter a Primary Rate of 125 ml/hr, VTBD of 2 ml, and set the Occlusion Limit to 300 mmHg.
5. Allow the pump to run one minute into the KVO mode.
6. Press (HOLD).
7. Enter the Biomed Menu (refer to 4.1).
8. Use the down 

to highlight "Check Configuration," then press (ENTER).
9. Press the down 

once.
10. Verify the value displayed is between 0 and 50, with a typical reading of 10-12. If the value is outside of these parameters, continue with additional testing.
11. Turn off pump and disconnect from AC power.
12. Remove the case top (refer to 9.3.1).
13. Press (POWER) to turn the pump on.

14. Using a voltmeter, test pin between pins 13 (neg) and 64 (pos) of J2 (mechanical interface connector) on the main PCB. With no pressure other than ambient pressure, the value should read between 50 and 600 mV, with a typical value in the 500 mV range. At higher elevations, the typical value will be less.
15. Brush your finger over the pressure transducer in the door to verify that the voltage increases as pressure is applied and returns to the previous no applied pressure value.
16. Replace the half door/bezel assembly if the voltage values or response are different from that described.

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6.12 RESTRICTION/OUTLET VALVE YOKE ADJUSTMENT TEST

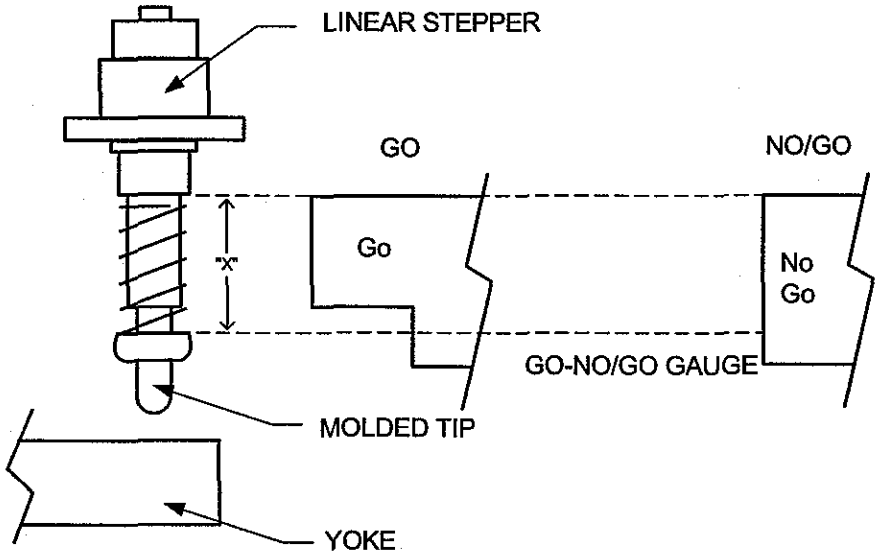
Perform this test whenever the restriction motor is exchanged or when a false downstream occlusion alarm (alarm code #24), and/or outlet valve cannot close alarm (alarm code #7) is experienced.

6.12.1 Equipment Required

- IV Source Container
- Pump IV Administration Set
- GO-NO/GO gauge

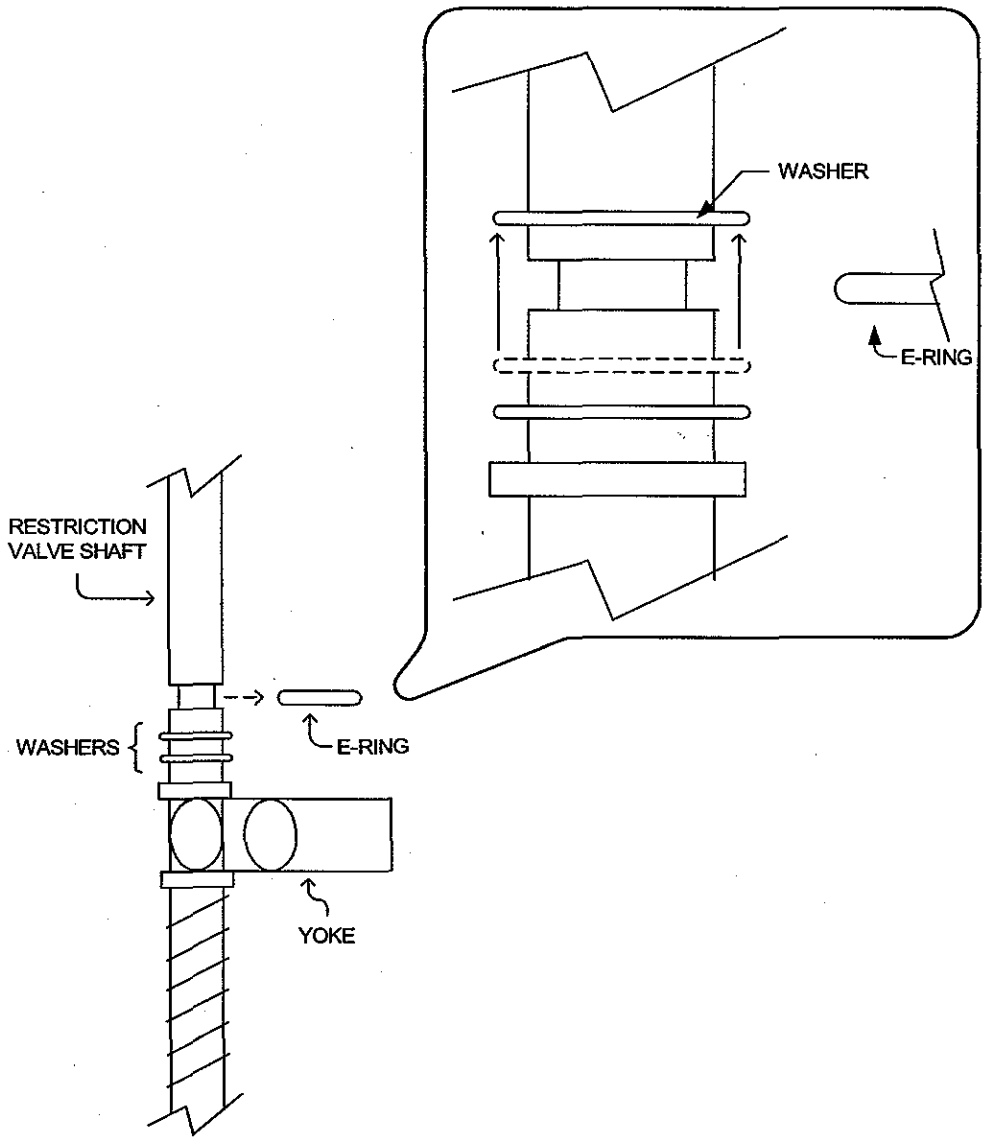
6.12.2 Test Procedure

1. Remove the case top (refer to 9.3.1).
2. Install a fully primed new (less than 72 hours old) cassette into the pump.
3. Power on and run the pump for two cycles at a rate greater than 500 ml/hr.
4. Press (HOLD).
5. Do NOT open the door.
6. Power the pump off.
7. Check the adjustment using the GO-NO/GO gauge. The GO side of the gauge should fit between the shoulder on the linear motor and molded tip, marked "X" on the diagram above. The NO/GO side should not fit. If this is true, then no adjustment is needed. If the GO side does not fit, continue to step 8. If the NO/GO side does fit, adjustment is necessary and proceed to step 9.



8. If the GO side of the gauge will not fit then move one 0.005" nylon washer to

the other side of the E-ring. This is done by removing the E-ring and moving one of the 0.005" washers above E-ring groove. Then reinstall E-ring and repeat steps 1-7.



9. If the NO/GO side of the gauge fits between the Linear/Restriction motor shoulder and molded tip, then a 0.005" washer should be moved to the other side of the E-ring. This is done by removing the E-ring and moving one of the 0.005" washers that are above the E-ring groove to below groove. Reinstall the E-ring. Then repeat steps 1-7.
10. Complete Sections 6.4, 6.6 and 6.8 of the Performance Check in this chapter.

NOTE: To relieve the spring force on the E-ring, open the door and press on the outlet valve tip.

6.13 INLET SOLENOID ADJUSTMENT TEST

Perform whenever a half door/bezel assembly is exchanged or repaired. Also needed for false or lack of downstream occlusion (Occlusion) alarms and false or lack of empty container (Bag Empty) alarms.

6.13.1 Equipment Required

- IV Source Container
- Pump IV Administration Set

6.13.2 Test Procedure

1. Loosen the screw which tightens the molded solenoid link to the solenoid plunger thread, just enough so that the solenoid plunger, the circular disk on rear of solenoid, is free to turn.
2. With a primed set in place, power on the pump and begin an infusion at some rate greater than 500 ml/hr.
3. Use the Inlet Solenoid Gap Gauge (P/N 398268 or equivalent non-magnetic feeler gauge) to verify the minimum gap between the solenoid and plunger is 0.008-0.016 inches. Measure when the plunger engages. The solenoid should be tight when using the .016 feeler gauge and barely touching when using the .008 feeler gauge.
4. If required, press (HOLD), then rotate the plunger in small increments and restart the infusion. Then recheck the gap. Repeat this until the gap requirement is met.
5. Tighten the screw on the solenoid link to lock the plunger into position.

CAUTION: Overtightening the solenoid link screw can break the solenoid link. Tighten only enough to prevent the solenoid plunger from rotating.

6. Complete sections 6.4, 6.6 and 6.8 of the Performance Check in this chapter.

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The following tests/procedures are recommended to complete the Outlook pump's Annual Preventative Maintenance Check.

6.14 ANNUAL PREVENTIVE MAINTENANCE (EVERY 12 MONTHS)

Because preventive maintenance is preferable to waiting until an instrument fails to function, it is recommended that the procedures for preventive maintenance be performed once each year.

6.14.1 Equipment Required

Tool Description	Size	Application
1. Phillips Head Screwdriver	#1 and #2	General
2. Small Blade Screwdriver	1/8" and 1/4" wide	General
3. Needle Nose Pliers		General

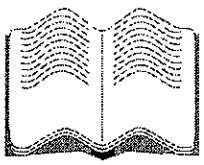
6.14.2 Procedure

If you have not been performing a battery capacity test during your prescribed performance checks, it is recommended (but optional) that you include this test in your annual PMs. B. Braun recommends replacing any batteries older than one year. Due to the length of time required to perform the test, you may wish to test only those devices which are used in an environment that charges the batteries in an erratic and infrequent manner, allowing them to fully charge very rarely, examples of which would be the Operating Room, Emergency Room and Recovery Room. Also included should be those devices which are suspected of having limited battery life. Refer to the section titled "Main Battery Capacity" for testing instructions.

Remove the case top as described in Section 9.3.

1. Check all components on the main PCB to ensure they are securely in place and undamaged.
2. Remove the battery from its case and inspect for damage. (refer to Section 9.2.1)
3. Check all connectors on the main PCB to ensure they are securely in place.
4. Visually inspect all hardware mechanisms on the Outlook to ensure that they are secure.
5. Replace the Petal Module Cover (refer to Section 9.14)
6. Reassemble the pump. Complete the Volume Delivery Accuracy Test (Section 6.4) and the Electrical Safety Check (Section 6.8) of the Performance Check in this chapter prior to use for patient care.

CHAPTER 7.0
THEORY OF OPERATION



IN THIS CHAPTER YOU WILL LEARN:

- About the general design features of the Outlook pumps.
- Of the functional and detailed description of the device's main components/assemblies.

The following describes the basic theory of operation for the Outlook pump. The organization of the material follows a general to specific format. The first section, 7.1, gives an overall description of a few significant design features. The next section, 7.2, is intended to give the reader a top level functional description. The third section, 7.3, provides detailed descriptions. Related schematics and drawings are cross-referenced where applicable. Additional schematics and drawings may be made available upon request.

7.1 GENERAL DESIGN FEATURES

7.1.1 Patient Safety

Patient safety was a primary concern in the development of the Outlook pump. The operation of the Outlook pump incorporates a product design with features that optimize the safety of prescribed infusions.

Alarm and troubleshooting information are clearly visible, easy to read, and provide specific directions to correct problems as well as a list of possible causes.

The **Alarm Log and Operations Log** use the Outlook's real time clock to record up to 255 separate events to assist in troubleshooting problems and documenting a specific series of events.

Automatic dose rate calculations are performed by Outlook's unique Dose Mode. Nursing convenience and dosing accuracy are enhanced by both this feature and the Drug Menus.

The **Barcode Scanning** feature (Outlook 200) automatically transfers infusion data from the IV source to the pump, thereby reducing the potential for transcription/data entry errors.

The Outlook's **ease of use** is one of the strongest factors contributing to patient safety. The method of operation is easy to learn. A wide variety of information provided by the data and information displays assist the user at each step of the infusion process.

Full visibility of operating parameters is accomplished with the Rate and VTBD Displays and the Information Display.

Reduced cord clutter around the bed-side results from using the Outlook's Daisy Chain approach to power cord management. Multiple pumps can be Daisy Chained together, only one of which needs to be plugged into the wall.

The Outlook's **Anti-Freeflow mechanism** provides protection against inadvertent free flow when the Pump IV Set is removed from the pump.

Tamperproofing of the user selected operating parameters is provided in two levels. Rate changes during operation require the operator to validate the change by pressing (ENTER) within six seconds. Complete lock out of the front panel is available by pressing the PANEL LOCK OUT button on the back of the pump.

User selectable variable occlusion pressure limits of 75 (approximately equal to gravity with fluid at 3.4 feet above the IV site), 100, 200, 300, 400, 500 and 750 mmHg settings allow the maximum occlusion pressure to be tailored to each patient's specific needs.

The innovative **Pole Clamp** design provides rapid and secure attachment to a variety of standard poles. While supporting the pump with both hands, the pump is attached to the pole, giving the user greater control of this process.

7.1.2 Ease of Operation and Repair

Ease of operation is enhanced by characteristics or features such as the Pole Clamp, stackability of pumps, Daisy Chaining of power cords, and a full array of displays that provide for optimal interaction between the pump and the user.

Ease of repair is facilitated through a modular approach to instrument design, assembly and disassembly. Rapid access to the interior of the pump is provided by an easily removed case top. The alarm and operations logs provide a variety of time and date stamped information that will assist in the repair and service of the Outlook pump. Battery replacement is facilitated due to the easily accessed compartment located beneath the pump.

7.1.3 Upgradability

The Outlook was designed with an eye toward the future. The modular design of the housing and internal assemblies makes access for service or upgrade simple. In addition, some connections are built into every Outlook for the addition of future options and accessories.

The most likely upgrade choice adds new software to the system. New software can be flash-loaded into the integrated circuits on the main board. The Biomed Menu can be used to identify the installed software versions.

7.2 FUNCTIONAL DESCRIPTION

The Outlook is a microprocessor-controlled volumetric infusion pump designed with advanced safety and convenience features for both the operator and the service technician. The modular internal design allows for rapid removal and installation of subassemblies for ease of problem diagnosis and repair.

The major subassemblies are: Case Bottom, Power Supply, Main Battery, Half Door/Bezel, Cosmetic Bezel and Key Panel, and Main Board. Inside the Door Subassembly is the LCD Display Board. There are three microprocessors which control most functions. They are as follows: Door Processor (DP); Management Processor (MP); and the Pump Processor (PP).

7.2.1 Case Bottom

The case bottom is the platform on which the rest of the Outlook is assembled. Attached directly to the case bottom are the fan, speaker, power supply, and the pole clamp. The fan is turned on by management software to cool the pump if its temperature rises too high or with rates >499 ml/hr. The bezel and door assembly slide into place on ribs in the case bottom, and the main board sits on posts above everything else. The case top fastens onto the case bottom with screws, locking the whole assembly together.

The case bottom and the other major case parts are painted with a conductive copper paint to provide EMC shielding for the entire system.

7.2.2 Power Supply

The Outlook power supply is mounted on a sheet metal chassis. An AC filtered power inlet connector and a hospital-grade outlet for daisy chaining multiple pumps is also provided. The power supply connects to the main board and supplies 16 volts to the system. The supply is a nominal 30 watt design using switching technology which reduces weight and increases efficiency.

7.2.3 Main Battery

The Outlook can operate from a built-in 12 volt 2.2 amp-hour sealed lead-acid battery. This battery connects to and is charged by a circuit on the main board. The battery fits into a compartment on the case bottom and can be changed through an access door.

7.2.4 Half Door/Bezel Assy.

The Outlook bezel is a plastic part to which is attached the pump mechanism components and the Air-In-Line block. The door and bezel become one assembly when attached together by the door hinges. The door and bezel assembly is positioned in the case bottom via gasketed tongue and groove joints. On the inside surface, it captures the cassette and tubing and holds the pressure transducer.

7.2.4.1 Half Door/Bezel Mechanism

The Half Door/Bezel Mechanism mechanically controls the flow-rate, volume,

and pressure of the fluid delivered. The various important parts of the bezel mechanism are the bezel, the inlet valve, the transfer valve, the restriction valve, the petal module, the refill piston, and the pressure transducer. In the following paragraphs, the mechanism is described as it is seen from the front of the pump.

The door of the pump limits the movement of the cassette and helps to contain the pressure required for pressurized fluid delivery. The door must be closed and securely latched for the pump to operate.

7.2.4.2 Restriction/Outlet Valve

The restriction/outlet valve is the right-most valve which extends through the bezel. The valve is under servo-control by the pump software and the restriction motor. The purpose of the valve is to provide the proper downstream resistance at the selected operating pressure. The restriction yoke has an optical sensor at the tip, called an optical yoke sensor, giving valve position information to the pump's system.

7.2.4.3 Petal Module

The function of the petal module is to pressurize the delivery chamber of the cassette. The petal module is located just to the left of the restriction valve and has a protective rubber cover. It is pushed forward by the main stepper motor during fluid delivery and retracts as fluid is pushed into the delivery chamber from the refill chamber during the refill operation. The pump system obtains main motor position from the main motor optical encoder.

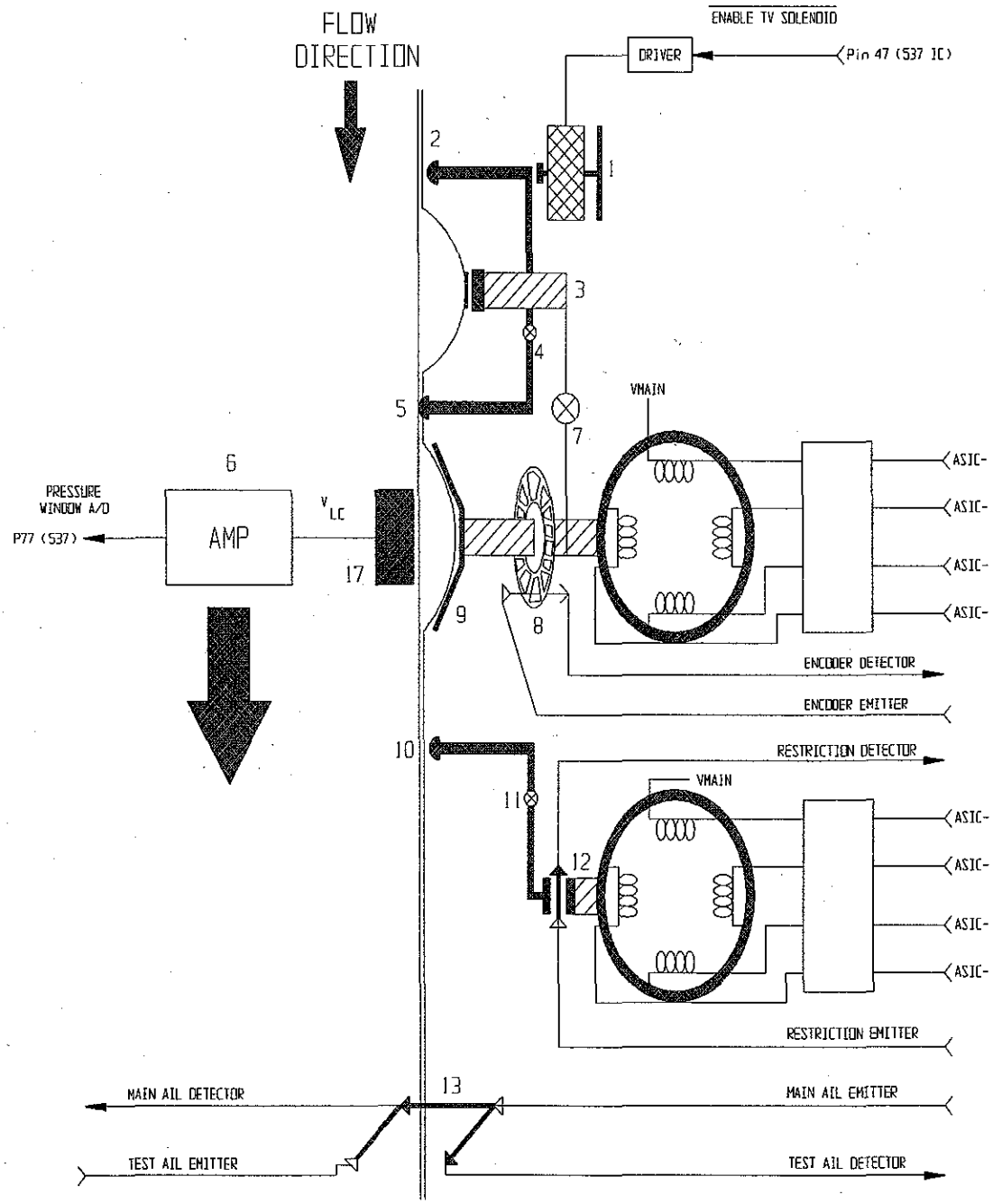
7.2.4.4 Refill Piston

The refill piston is inversely and mechanically linked to the main motor drive. This allows the cassette to refill while the petal module is delivering. The refill piston is the large disc to the left of the petal module. The face of the piston is a magnet of special construction. It has unusually strong magnetic properties, which allows the piston to remain attached to the metal disk, part of the refill chamber of the cassette, even when refilling from a fluid supply positioned below the inlet of the pump (a negative head height).

7.2.4.5 Transfer and Inlet Valves

The transfer valve controls the transfer of fluid from the refill chamber of the cassette to the delivery chamber and is located between the petal module and the refill piston. The inlet valve controls the flow of fluid into the refill chamber and is located to the left of the refill piston. These two valves are mechanically linked to provide inverse operation and are operated by the pump system via the transfer solenoid.

7.2.4.6 Mechanism Operational Sequence



7.2.4.7 Mechanism Operational Sequence

The Outlook uses a cyclical volumetric displacement method to deliver fluid. At the beginning of a pumping cycle, the restriction (10) and transfer (5) valves are

closed, the inlet (2) valve is open, the petal module (9) is back and the cassette delivery chamber is full (cassette portion attached to 9), the refill piston (3) is forward and the cassette refill chamber (cassette portion attached to 3) is empty.

The petal module (9) is attached to the bezel and is driven by the main stepper motor shaft via a screw thread. Once (RUN) is pressed, the petal module assembly is driven forward until the selected delivery pressure (6) is achieved, and delivery begins. At the same time, the refill piston moves in the opposite direction, because it is mechanically connected through a pivot point (7). The main stepper motor drives the petal module forward a certain number of steps each cycle to deliver a precise amount of fluid. The delivery is approximately linear; for each main stepper motor step an equal amount of fluid is delivered. As delivery proceeds, the restriction valve opens and closes as the pump software reacts to varying fluid line conditions to maintain constant pressure in the delivery chamber.

As the petal module moves forward under stepper motor control, the refill piston moves back to allow entry of fluid from the container while the inlet valve is open. The encoder wheel (8) is optically monitored to give positive indication of motion. Pressure is monitored by a load cell (17) whose output goes to an amplifier (6). The amplifier output has separate offset and gain controls.

When the delivery cycle is complete, the restriction motor causes the restriction/outlet valve to close through a pivot point (11). The tip of the restriction motor is optically monitored to detect the point just before the valve starts to open. The transfer solenoid (1) energizes, causing the transfer valve to open and the inlet valve to close because it is mechanically connected through pivot point (4), and the petal module retracts as the refill piston moves forward to transfer fluid from the refill chamber to the delivery chamber. When the transfer is complete, the solenoid changes state and a spring forces the transfer valve to shut and the inlet valve to open and the delivery cycle is repeated.

7.2.4.8 Mechanism Interface Board

The mechanism interface board is the connection point between the main board and the bezel and door assemblies. One large connector mates with the main board and from there, connectors are provided for the main stepper motor, main motor encoder, restriction motor, restriction optical yoke, transfer solenoid, air-in-line block, and door assembly.

7.2.4.9 Air-In-Line Block

The air-in-line block is an optical bubble detector which the system uses to prevent pumping air to the patient. The set tubing is pressed tightly into the slot in the block by a spring-loaded pusher in the door. When a bubble above a certain size is detected, the pump will stop pumping and alarm.

7.2.4.10 Display Board

The display board is the PCB inside the door. It contains the red LCD display digits to the left and the 128 x 64 LCD display to the right. The door processor software receives commands from the management processor on the main board, controls the LCD displays, processes key panel inputs, controls the LCD display's visual contrast and backlight, controls the display and transducer board memories.

7.2.4.11 Pressure Transducer

The transducer is essential to the operation of the pumping mechanism. It measures fluid pressure in the delivery chamber of the cassette. The circuitry amplifies this pressure signal before it is sent to the pump processor on the main board.

The face of the pressure transducer is made of a rubber compound that transmits pressure from the window in the delivery chamber of the cassette to a sensor in the body of the transducer. The transducer face is covered with a special Teflon tape to protect it and reduce friction with the cassette.

7.2.5 Main Board

The main board is the center of the Outlook's electronics system. It contains the management processor, pump processor, and their associated Flash PROMS. The Flash PROMS hold the software programs which control the operation of the rest of the system. The main board mounts on three posts which are part of the case bottom, and has connections to the mechanism interface board, main battery, power supply, fan, and speaker.

A switch located at the rear of the board is used to enable or lock out user access to the key panel on the front of the pump while it is running. Also, at the rear of the board is a communication connector. This connector allows the pump to send and receive data when used with the Outlook Biomed Box (set up of configuration data, downloading of operation logs, and flashing of new application software).

The main board performs all pump mechanism control functions. It has charging circuits for the batteries. It controls the audio alarm, and has a backup alarm beeper and battery on board.

7.3 POWER SUPPLY ASSY.

WARNING: Use a line isolation transformer and caution whenever working on an energized supply. Failure to do so could result in bodily harm. A large portion of the Outlook power supply board is connected directly to the AC line and contains high voltages.

The Outlook power supply is a switching supply that converts AC line voltage to 16 volts DC for charging the battery and running the pump. AC power enters the supply through an electromagnetic interference (EMI) filter with an input connector. Note that the Daisy Chain outlet is not fused, which is why it should only be used for other Outlook pumps.

7.3.1 16 Volt Supply

WARNING: Do not work on this circuit without using a line isolation transformer to isolate the "neutral" input conductor from earth ground. Failure to do so could result in bodily harm. The ground reference shown in the primary or high voltage side of the 16 volt supply is not the same as circuit ground throughout the rest of the pump, and it is different from earth ground.

The power supply can use a nominal AC line supply of 120 VAC.

7.4 DISPLAY BOARD ASSY.

The LED display board acts as the central connection point inside the Outlook door assembly. The 34-conductor cable from the bezel assembly brings all signal and power lines to the display board, and from there some are distributed to the transducer and LCD boards. The first of the two LCD's is a 128 x 64 Graphics transflective, STN, positive image display. The backlight used with this LCD is a green EL panel.

The second LCD is a 80- 16 Graphics transflective, FSTN, negative image display. The backlight used with this LCD is a Red LED backlight.

The LCD module utilizes one printed circuit board assembly (PCBA). The LCD PCBA will be located directly behind the displays and will incorporate LCD drive circuitry, DC-DC converters, temperature compensation circuit, microprocessor, LED's, keypad interface, SRAM and miscellaneous discrete components. The microprocessor software is an integral part of the LCD module. The software is developed and provided as part of the module.

7.4.1 Door Processor

The heart of the display board is the door processor IC. This is a single-chip microprocessor with an internal program which controls the Red LCD displays, the interface to the membrane key panel, the inverter for the LCD display backlight, and the contrast voltage supply for the LCD display. Secondary functions it performs are reading the nonvolatile configuration memories on both the display and pressure transducer boards. Memory internal to the door processor is used to store display content and other control status information sent from the management processor. This data is lost at power-off and must be restored from the management processor when power is restored.

The door processor behaves as a slave to the management processor on the main PC board. After reset, it turns on the AC indicator Green LCD and waits for commands from the management processor. Communication with the main board is controlled by the management processor and uses four signal lines: SYNCDAT, SYNCCLK, DOORCTS, and DOORRTS. Communications use a synchronous serial format, with the synchronous clock generated by the management processor. If the management processor wishes to send a message to the door processor, it sends one or more bytes with one clock pulse for each bit. If the door processor wishes to send a message to the management processor, it uses DOORRTS to request it, and the management processor uses DOORCTS to indicate its readiness, and the message byte is then transferred by the management processor's clock pulses. These message signals can be observed even when the pump is idle, since each processor sends an "I'm O.K." message every few seconds for safety purposes.

Messages between the two processors have parity bits so that communication errors can be detected and an alarm generated.

7.4.2 Key Panel Interface Assy.

The second most important function of the door processor is to interface with the switches in the membrane key panel. The key panel connects to the display board through two 7-conductor flexible tails. The (POWER) key on the key panel connects straight through to the main PCB to control power-up and power-down sequences. The other key panel internal switches form a five by six matrix which is connected to the door processor circuitry. Each switch on the panel is connected between one "row" and one "column" of this matrix, which is scanned for pressed keys during part of the display multiplexing process. During a time when they are not driving an LED segment, one of six door processor ports is held low. This pulls one of six key panel columns down to ground through a diode. The five key panel rows are each pulled up to Vcc by a resistor, and are tied to five door processor inputs. If a switch contact on that key panel column is closed when this happens, then that switch's row is pulled low so that one of the door processor's inputs is pulled low. In this way, the software can tell by scanning all six columns which switches are closed. This scanning process is very rapid and is synchronized with the LED multiplexing. If a switch is held down long enough, about $1/30^{th}$ of a second, then the door processor will send a message to the management processor saying that the key has been pressed. If the key remains held down, then a periodic "key still down" message will be sent.

A flexible circuit jumper is part of the key panel tail, and ties one of the five row lines to a special door processor pin. The processor can use this pin to tell which line the jumper is tied to, which tells it the specific key panel type. In this way, future key panels with different switch arrangements or graphics could be identified for use with special software versions.

If the door is open, the management processor will generate audio clicks if the key panel switches are pressed, but no other action will be taken. This is to prevent accidental data or status changes caused by something underneath the open door.

7.4.3 LCD Contrast Voltage

A voltage regulating IC (VRIC) generates a regulated voltage that is supplied to the LCD display module, which controls the visibility, or contrast, of the display elements on the LCD screen. This VRIC and the surrounding circuitry takes VMAIN, which ranges from 11 to 16 volts, and generates a negative voltage supply (Vlcd). This voltage is regulated by the VRIC, but it is influenced by two other factors. First, since LCD contrast is affected by temperature, thermistor, CT1, causes Vlcd to change with temperature to match the display. If the display is cold, the voltage should be more negative, if it is warm, the voltage should be less negative. In addition, three output pins from the door processor can shift Vlcd. These three pins can be set to eight different combinations (0-7) which can give eight different levels of Vlcd, which are controlled by software from the User Menu item "Set LCD Contrast." This setting is saved in management processor RAM memory and is restored at power-up. Vlcd has a normal adjustment range from -7 to -8.5 volts.

The door processor uses transistor Q4 to supply Vlcd to the LCD display. At power-up, it is not turned on until the LCD controller has been initialized and the management processor sends an "LCD ON" command to the door.

7.4.4 LCD Backlight Supply

The LCD display module contains an electroluminescent panel which is used to backlight the display so it can be viewed in dim lighting conditions. Voltage is generated by a DC to AC converter mounted on the display board. The door processor, commanded by the management processor, controls the VMAIN supply to the inverter, which turns the backlight on and off. An electroluminescent panel has a limited operating life, over which it grows dimmer, so the management software turns off the backlight when no user interface activity is taking place.

7.4.5 LCD Module Assy.

The Liquid Crystal Display module is a combined LCD screen, driver electronics board, and electroluminescent backlight. It is not repairable to the component level. It is a "transflective" type of display, with a built-in reflector for viewing in brighter light, and a transmissive backlight for viewing in dim or no light.

The LCD panel contains 1024 square elements (pixels) arranged as a 128 pixel wide by 64 pixel high array. Control signals for the display are generated by the LCD controller, and are all logic level signals. The actual voltage (Vlcd) that turns on the LCD pixels is a negative voltage (-7 to -8.5 volts) generated on the display board and adjusted (under operator control through the User Menu) by the door processor. This voltage also varies with temperature, since the behavior of the LCD is temperature sensitive. This allows the display to work over a temperature range without requiring adjustments.

The backlight is a solid-state electroluminescent (EL) sheet which glows when energized. The glowing phosphors in this panel tend to glow less brightly as time goes on, so the backlight is turned on and off under management software control. After the pump starts running, the backlight is turned off to extend its useful life. Once the backlight is turned off, pushing any key panel key will turn it back on so that the display can be seen in dim light.

7.5 PRESSURE TRANSDUCER

7.5.1 Pressure Transducer Circuits

The pressure transducer converts the pressure applied to its surface membrane to a differential output voltage. The pressure transducer is powered by a constant current source, which is generated by op amp, 2.5 volt reference, and a 1.65K ohm current setting resistor. The op amp maintains 2.5 volts across the resistor, which results in a constant 1.5 milliamps out of the pressure transducer supply return terminal. The differential pressure transducer output is sensed by another op amp, which has unity gain.

7.5.2 Offset, Gain, and Output Circuits

The sensed pressure transducer output signal is amplified and adjusted for offset errors, by means of a summing amplifier, with a signal gain of 47.5. The amplifier sums the inputs from the pressure transducer sense amplifier, the 2.5 volt reference, and the -2.5 volt reference. The contribution from the sensed pressure signal is scaled by the ratio of feedback resistor R2 to input resistor R5, which provides a signal gain of 47.5. The contribution from the 2.5 volt reference is scaled by the ratio of feedback resistor R2 to input resistor R8. Therefore, R8 is selected to correct for negative offset errors. The contribution from the -2.5 volt reference is scaled by the ratio of feedback resistor R2 to input resistor R7. Therefore, R7 is selected to correct for positive offset errors.

Op amp U3B inverts the offset adjusted pressure signal to complete the formation of a differential output with maximum range.

7.6 MECHANISM INTERFACE BOARD ASSY.

The mechanism interface board is the connection point between the main board and the bezel and door assemblies. One 100-pin connector mates with the main board and from there, connectors are provided for the main stepper motor, main motor encoder, restriction motor, restriction optical yoke, transfer solenoid, air-in-line block, and door assembly. The connectors are polarized and sized so that the mechanism components cannot be plugged in incorrectly. The door cable assembly is built with special high flex-life ribbon cable to withstand the large number of door operations over the life of the pump.

7.7 MAIN BOARD ASSY.

The main board utilizes a dual processor architecture, for both efficiency and reliability. One of the processors, the management processor, is primarily responsible for interpreting operator inputs, initiating fluid delivery operations, and generating display information. The other processor, the pump processor, is primarily responsible for controlling fluid delivery operations, as directed by the management processor. An application specific integrated circuit (ASIC) generates the waveforms that control the two motors during fluid delivery, as directed by the pump processor. The ASIC also provides all address decoding for the management processor, and provides the interface between the external photo-interrupter LEDs and both processors.

7.7.1 Management Processor

The management processor is a V25 Plus microcomputer, which is software compatible with the 8086 microcomputer. It uses a 16 bit internal data bus and an 8 bit external data bus. The V25 Plus can directly address 1M byte of memory and 1M byte of I/O. Memory accesses are controlled by Memory Request (MREQ), Memory Strobe (MSTB), and Read/Write (R/W). I/O accesses are controlled by I/O Strobe (IOSTB) and Read/Write (R/W). The V25 has two serial channels and four multifunction I/O ports, including one 8 bit analog comparator port for discrete or analog inputs. The microprocessor operates at a clock frequency of 12 MHz, which is supplied by a crystal and an internal oscillator.

The management processor program is stored in an external 512 K byte EEPROM, and data is retained in an external 128K byte RAM. The RAM write line is gated by Memory Strobe with a NAND gate to provide the necessary address setup time. The RAM is backed up with a 3 volt on-board battery which is switched in or out by a power supervisory integrated circuit. Therefore, data will be retained in RAM even if the board is removed from the system. Pullup and pulldown resistors on the data bus ensure that an Interrupt 3 instruction will be retrieved by the microcomputer if non-existent memory is addressed.

7.7.2 Door Interface Bus

The management processor communicates with the external door processor via a bidirectional, synchronous serial bus. The management processor uses port pin P14 to transmit and receive data on the data line, and it uses port pin P17 to drive the clock line. The door processor requests permission to transmit a message by raising a flag on the DOORRTS line (management processor port pin P07). The management processor then grants permission to send by raising a flag on the DOORCTS line (management processor port pin P21). The DOORRTS and DOORCTS lines are not used when the management processor sends messages to the door processor, since the door processor is normally ready to receive. The management processor can reset the external door processor with the RESETDOOR line (port pin 22).

7.7.3 Display Board Interface

The management processor can write commands and display data to, and read status and display data from, the external LCD controller, via an 8 bit parallel data path. The 8 bit data path is buffered by an octal bidirectional buffer. The management processor Memory Strobe is gated with the Read/Write line by two NAND gates to produce an LCD read and an LCD write line. An LCD select line is generated by the ASIC. It is decoded from management processor memory address space, from 400 hex to 401 hex. A single address line, A0, buffered by a NAND gate provides 2 LCD read addresses and 2 LCD write addresses. This allows the management processor to write LCD commands, write LCD data, read LCD data, and read LCD status.

7.7.4 Communication Data Port

ATTENTION: The DB9 connector on the back of the Outlook pump is for use by authorized personnel only.

The management processor can transmit to and receive serial data from an external host by means of a full duplex, asynchronous connection. One of the two serial ports in the management processor is dedicated for this purpose.

7.7.5 Pump Processor

The pump processor is a C517 microcontroller which is based on a superset of the 80C31 architecture. With 16 address bits, the C517 microcontroller can directly address 64K bytes of program memory and 64K bytes of data memory. Eight output pins are dedicated to the upper eight address bits, but the lower eight address bits are multiplexed with the 8 bit data bus. Therefore, the lower eight address bits must be stored in the latch with the falling edge of Address Latch Enable (ALE) before the eight data bits are presented on the same lines. Program memory fetches are controlled by Program Store Enable (PSEN), data memory reads are controlled by Read (RD), and data memory writes are controlled by Write (WR).

The pump processor program is stored in an external 64K byte EEPROM and data is retained in an external RAM. Pulldown resistors on the data bus ensure that a NOP instruction will be retrieved by the microcontroller if nonexistent memory is addressed.

In addition to its address and data ports, the C517 microcontroller has five 8 bit multifunction I/O ports, two serial channels, and 12 A/D inputs. The C517 microcontroller operates at a clock frequency of 12 MHz, which is supplied by a crystal and an internal oscillator.

7.7.6 Interprocessor Communications Bus

The management processor and the pump processor communicate with one another through dedicated full duplex asynchronous serial ports. The management processor can transmit messages to the pump processor at any time over the V25TO537 line, and the pump processor can transmit messages to the management processor at any time over the 537TOV25 line.

7.7.7 ASIC

The ASIC interfaces with both the management processor bus and the pump processor bus. It performs all address decoding for the management processor, performs I/O address decoding for the pump processor, generates stimuli for external sensors, and generates motor drive waveforms for the main motor and restriction motor.

7.7.7.1 Address Decoding and Stimuli

The AIL LED, test AIL LED, main motor encoder LED, restriction valve LED, Anti-Freeflow Clamp LED, and the door switch can all be energized by either the management processor or the pump processor.

7.7.7.2 Motor Controller

The ASIC receives motor commands from the pump processor bus, and generates pulse width modulated (PWM) waveforms for the main motor and the restriction motor. Both motors are four phase, unipolar stepper motors. A single command from the pump processor can result in no more than a single step from a single motor, so the motors are always under strict processor control. The eight PWM motor waveforms are re-driven by eight N-channel FET's with transient suppression diodes. The resulting drive signals are then routed to the motor windings. The eight PWM motor waveforms in the ASIC can be completely inhibited by the LATALARM signal from the EPLD. See section 7.7.12.2 "Power Controller EPLD" for a description of LATALARM.

The ASIC controls the duty cycle of the PWM waveforms, as directed by the pump processor, which in turn determines the average current through the motors. The pump processor can also command the ASIC to ramp the duty cycle of the PWM waveform up or down over a selectable period of time, at the beginning or end of a motor step. This is done to reduce the acoustical noise when a motor step is applied.

7.7.7.3 ASIC Timers

The ASIC also contains two programmable timers, one for each motor, to ensure that the motor stepping rates selected by the pump processor are accurate. Any pending main motor step command is automatically executed when the main motor timer times out. In addition, the main motor timer issues interrupts to the pump processor at three different points: when the timer times out, three timer clock periods before the timer times out, and seven timer clock periods before the timer times out. The main motor timer clock period can be programmed to be either 341 microseconds or 2.73 milliseconds. The restriction motor timer issues interrupts to the pump processor only when its timer times out. Any pending restriction motor step command is automatically executed at that time. The restriction motor timer clock period is 685 microseconds.

7.7.8 Transfer Valve Solenoid Driver

The pump processor generates the PWM waveform for the transfer valve solenoid by means of a built-in timer/comparator circuit, using port pin P4.7. The pump processor reduces the duty cycle of the waveform after initial pull-in of the solenoid, in order to minimize power consumption. The PWM motor waveform is inverted by a P-channel FET and driven by an N-channel FET with a transient suppression diode. The resulting drive signal is then routed to the solenoid winding. The other side of the solenoid is connected to VMAIN.

7.7.9 Temperature Controller

The pump processor monitors the air temperature inside the case with a thermistor, TH1, through A/D port pin P7.0. If the temperature exceeds a preset threshold, the pump processor turns on a cooling fan, through port pin P6.4. The fan signal is re-driven by an N-channel FET with a transient suppression diode and a 7.5 volt zener diode before being routed to the fan motor.

7.7.10 External Sensor Interface

7.7.10.1 Panel Lock Out Switch

The panel lock out switch is a single pole, double throw, momentary switch, which is mounted on the main board. It is accessible to the user through a flexible membrane in the rear of the case. The state of the switch signal is monitored by the management processor, via port pin P05. The software toggles between the lock out mode and the non-lock out mode with each depression of the switch.

7.7.10.2 Door Switch

The door switch is a single pole, double throw, magnetically operated switch, which is mounted in the bezel. The switch is closed by means of a magnet in the door whenever the door is closed. The state of the switch is monitored by the management processor, via port pin P01. The switch is directly energized by the

STIM signal, which can be generated by either processor via the ASIC. Therefore, the management processor can distinguish between a switch signal that is stuck low and a real closed door condition, by toggling the STIM signal.

7.7.10.3 Encoder and Restriction Valve

The position of the main motor is determined by counting pulses from an encoder wheel mounted to the motor shaft. The motor is first initialized to a known position by retracting it to its extreme limit. The pulses are generated by a photo-interrupter assembly, which detects the alternate spokes and holes in the encoder wheel. The encoder output signal remains high for approximately four main motor steps and low for approximately six main motor steps. This output, ENCODERSEN, is received by an inverted Schmitt trigger on the main board, and then routed to both processors.

The position of the restriction valve is determined by counting restriction motor steps. The restriction valve is first initialized to a reference position (fully closed position) by moving it to the position where the restriction motor shaft makes initial contact with the spring loaded valve linkage. At this point, the output from a photo-interrupter assembly in the valve link makes a transition in logic levels: high for contact, low for no contact. This output, RESTRSEN, is received by an inverted schmitt trigger on the main board, and then routed to both processors.

The LEDs in both photo-interrupter assemblies are connected in series, and energized by the STIM signal generated in the ASIC. The STIM signal is re-driven by a transistor and current limited with a 220 ohm resistor before being routed to the LED's.

7.7.10.4 Air-In-Line Block

Air bubbles in the line are detected by means of the air-in-line block. The air-in-line block printed circuit board contains two separate infrared LED/photosensor pairs, with current limiting LED resistors. One pair, the AIL pair, utilizes the different indices of refraction of air and liquids to detect air bubbles in the line. Its LED is energized by the AILLED signal generated in the ASIC. The AILLED signal is re-driven by a transistor before being routed to the AIL board. The output of this pair, AILSEN, is received by a comparator and then routed to both processors. In normal operation, AILSEN is high for air and low for liquids.

Another LED/photosensor pair, the TESTAIL pair, is used to test the operation of the AIL LED and photosensor. The TESTAIL LED is positioned to emit infrared light directly onto the AIL photosensor. The AIL output signal is high when the TESTAIL LED is on. The TESTAIL LED is energized by the TESTAILLED signal generated in the ASIC and re-driven by a transistor before being routed to the AIL board. The TESTAIL photosensor is positioned to detect

infrared light emitted by the AIL LED. Its output signal, AILTESTSEN, is received by a comparator and then routed to both processors. AILTESTSEN is high when the AIL LED is on.

7.7.11 Power

The main board circuits are powered by the external power supply, an onboard voltage regulator, an onboard power converter, the main battery, and two onboard batteries.

7.7.11.1 VSUPPLY

When the Outlook is plugged into an AC outlet, the power supply generates 16 volts on the VSUPPLY line. The main board then uses VSUPPLY to generate 5 volts on the VCC line. The main board provides the DC source by means of an external main battery, which can be connected to VSUPPLY under software control, through a 2 amp fuse, FET, and a diode. VSUPPLY will reflect the value of the higher of the two sources: 16 volts when the Outlook is plugged in, 12 volts when it is turned on but not plugged in, and zero when it is not turned on and not plugged in.

7.7.11.2 VMAIN

All of the VSUPPLY current that is used by or distributed by the main board is measured through a series .05 ohm resistor and an op amp. The pump processor monitors the op amp output through A/D input P7.3. The node on the load side of the .05 ohm resistor is called VMAIN.

7.7.11.3 VBATT

The external 12 volt lead-acid battery is connected to the main board circuitry through a 2 amp fuse on the main board. The node on the load side of the fuse is called VBATT. The battery voltage is measured by an op amp, through two sense wires provided for that purpose: BATTSEN+ and BATTSEN- . The output of the op amp is monitored by the pump processor, through A/D input P7.2.

In addition to the analog measurement of VBATT, two comparator circuits are provided to monitor the condition of the battery. The LOWBATT signal is generated by a comparator and a 2.5 volt reference whenever VBATT is less than 10.5 volts. LOWBATT is connected to the management processor non-maskable interrupt input, P10, and to pump processor input P3.2. The DEADBATT signal is generated by a comparator and a 2.5 volt reference whenever VBATT is less than 10.3 volts. DEADBATT is connected to the power controller EPLD.

The main board maintains the charge on the main battery by means of a battery charger integrated circuit which is powered by VSUPPLY. The battery charger automatically switches between three different charge states, depending on the condition of the battery: a high current bulk-charge state, a controlled over-

charge state, and a precision float-charge, or standby, state. The pump processor can disable the charger during battery operation.

7.7.11.4 V+

V+ is produced from 12 volts or 16 volts on VMAIN by an onboard eight volt voltage regulator, VR1.

7.7.11.5 V-

-8 volts is produced from 12 volts or 16 volts on VMAIN by an onboard switched capacitor voltage converter with regulator. The -8 volt regulator output is gated by a FET which outputs -8 volts on the V- line. The FET is provided to ensure that V- cannot become positive during power-up.

7.7.11.6 VMEM

A 3 volt, 280 ma-hr, non rechargeable lithium battery is provided on the main board, as a backup power source for VMEM. VMEM powers the management processor RAM and the time-of-day integrated circuit. A power supervisory integrated circuit connects either the 5 volt VCC or the 3 volt battery voltage to VMEM, whichever is higher. Therefore, information stored in the RAM and the time-of-day integrated circuit is maintained, even when the main board is removed from the Outlook.

7.7.11.7 VBKUP

A 4.8 volt battery pack is provided on the main board, as a backup power source for VBKUP. The battery pack consists of four rechargeable, 1.2 volt, 100-110 ma-hr, nickel-cadmium batteries. VBKUP powers the backup alarm, the power controller EPLD, the power switch circuits, the 2.5 volt reference, and the main battery threshold detectors. Therefore, the backup alarm will be operable, even if the Outlook is not plugged in and the main battery is dead. The 4.8 volt battery pack is charged by a diode and a resistor whenever power is available from VSUPPLY.

VBKUP normally obtains power from VCC through a diode whenever VCC is available. It obtains power from the 4.8 volt battery pack or VSUPPLY through another diode and a FET only if the Outlook has been turned on. It also obtains power from VBATT through a resistor, diode, and FET if the Outlook has been turned on.

7.7.12 Power Control Circuits

When the Outlook is turned off and not plugged into an AC power source, pressing the power switch will activate the circuits that apply main battery power to the main board. Then, when the 5 V Regulator applies VCC to the processors, they will detect the active power switch signal, and begin normal operation. The next time the processors detect an

active power switch signal, they will prepare the Outlook for power-down, and activate their battery-disconnect signals. When the power controller EPLD receives battery-disconnect signals from both processors, it will disconnect the main battery. At this point, the instrument will be unpowered again. When the Outlook is plugged into an AC power source, power-up and power-down proceeds logically the same as when it is not plugged in, except that the electronics remain powered. That is, the circuits remain powered when the Outlook is turned off, but only the main battery charger and the AC LED indicator are active.

7.7.12.1 Power Switch Circuit

The power switch is a simple membrane switch located on the front key panel, with one side connected to ground. The other side is connected through a diode to the gate of a FET. When the power switch is pressed, the FET immediately applies power from VSUPPLY, VBATT, or the 4.8 volt battery pack, to VBKUP. VBKUP then powers the remainder of the power control circuits, thus enabling the subsequent stages of the power-up process.

The power switch is also connected through a diode to the input of a comparator, resistor, and capacitor. When the power switch is pressed, the comparator output, SW, is immediately asserted. When the switch is released, the resistor and capacitor delay the deactivation of the SW signal. Therefore, short pulses from the power switch are stretched to a usable length of time. The SW signal is routed to both processors and the power controller EPLD.

7.7.12.2 Power Controller EPLD

The power controller electrically programmable logic device (EPLD) performs several different functions. It controls the connection of the 12 volt battery to VSUPPLY, it controls the connection of the 4.8 volt battery pack to VBKUP, it activates the backup alarm in response to various input conditions, and it performs address decoding for the pump processor. When the EPLD detects the SW signal during the power-up process, it asserts the CONVBKUP and the CONVBATT signals. The CONVBKUP signal turns on FET after an approximate 50 millisecond delay, which is induced by a resistor and capacitor. FET then enables another FET, which connects the 4.8 volt battery pack to VBKUP. At this point, the operator can release the power switch, and the power-up process will continue. The CONVBATT signal is inverted by FET, which enables another FET Q35, which connects VBATT to VSUPPLY through a diode. The next press of the power switch will not normally affect the EPLD directly. However, the processors will interpret the key press as a request for power-down. After preparing the instrument for power-down, the management processor will assert the DISCONA signal via port pin P06, and the pump processor will assert the DISCONB signal via port pin P5.7. When both processors have asserted their disconnect signals, the EPLD will disconnect the 4.8 volt battery, unless the backup alarm has been activated, and it will disconnect the main battery.

The EPLD activates the backup alarm via the BKUPALARM signal whenever both CONVBKUP and RESET are asserted. Therefore, RESET normally causes a short beep from the backup alarm circuit, prior to the chime from the primary alarm circuit, when an unplugged instrument is first turned on. The EPLD also activates the backup alarm whenever the EPLD latched output signal, LATALARM, is asserted. Pressing the power switch after LATALARM has been asserted will cause the EPLD to immediately silence the alarm, and disconnect both the 4.8 volt battery and the main battery. LATALARM is asserted under four different conditions, which are described below.

CONDITIONS RESULTING IN LATALARM SIGNAL

1. The pump processor issues an ALARMON signal, via port pin P5.2.
2. The management processor issues a SHUTDOWN signal, via port pin P02.
3. The Comparator generates a DEADBATT signal. DEADBATT also causes the EPLD to disconnect the main battery, to protect it from permanent damage.
4. An extraneous RESET signal is generated after the normal power-up RESET. The possible causes of extraneous RESET's are described in the Power Supervisory Circuit section.

The EPLD also decodes addresses for the pump processor. The single decoded output, C517 RAM, is routed directly to the pump processor RAM and the ASIC, without diode protection. Therefore, the C517 RAM output line is forced low by the RESET line whenever VCC is not available, to avoid the possibility of sourcing an unpowered component through an input pin when the EPLD is powered by the 4.8 volt battery.

7.7.12.3 Power Supervisory Circuit

The power supervisory circuit performs several functions. It generates resets under various input conditions and controls backup power for the management processor RAM and the time-of-day circuit.

The power supervisory circuit constantly monitors VCC, and generates a minimum 35 millisecond reset on the RESET line if VCC falls below 4.75 to 4.5 volts. Therefore, RESET is always asserted on initial power-up and during subsequent negative glitches on the VCC line. Reset is also generated by the overvoltage detection circuit whenever VCC exceeds 5.32 to 5.6 volts for 4-15 milliseconds. See the section 7.7.19 "Overvoltage Detection Circuit." The power supervisory circuit also asserts the RESET line whenever its watchdog circuit times out. The watchdog time-out period is 1.6 seconds. The watchdog circuit is normally prevented from timing out by pulses generated by the pump processor, via port pin P6.0. A reset can also be forced by holding the TESTRESET line from the option connector either low or high for 1.6 seconds. This nor-

mally open-circuit line is connected to the power supervisory circuit watchdog input, along with the watchdog input signal from the pump processor.

Both VCC and the 3 volt battery are connected to the power supervisory circuit. During normal operation, the power supervisory circuit connects VCC to the VMEM line, which provides power to the management processor RAM, and the time-of-day integrated circuit. The power supervisory circuit BATON output signal also enables a separate PNP transistor, which provides additional current from the VCC line to VMEM. However, when VCC falls below the voltage level of the 3 volt battery, the power supervisory circuit asserts the RESET signal, and switches the 3 volt battery power onto the VMEM line instead. The 3 volt battery power is sufficient to maintain the data in the management processor RAM and to maintain the current time in the time-of-day integrated circuit. The RESET line is also routed to one of the management processor RAM enable inputs in order to inhibit writes when VCC is low.

7.7.13 Voltage References

Two voltage references are supplied on the main board. A 5 volt reference voltage is generated by an integrated circuit which is powered by V+. The source current from V+ passes through a red indicator LED and a voltage dropping resistor before reaching the integrated circuit. Therefore, the LED provides an "ON" indication for service technicians without using additional power. The 5 volt reference is used by the A/D converter inside the pump processor, the analog comparators inside the management processor, the offset DAC in the pressure signal circuits, and the thermistor in the temperature control circuit.

A 2.5 volt reference voltage is generated by a precision virtual ground integrated circuit which is powered by VBKUP. The 2.5 volt reference is used by the LOWBATT and DEADBATT comparators.

7.7.14 Pressure Signal Circuits

The pressure signal circuits receive the differential output signal from the pressure transducer, VPRESS+ and VPRESS-, and perform several processing operations before presenting the results to the A/D converter inside the pump processor. The differential input signal is first converted to a single ended signal by an op amp. Then the single ended signal is level shifted and amplified under control of the pump processor. The shifted and amplified signal is then routed through a diode/resistor clamping matrix, and presented to the A/D converter inside the pump processor. The software controlled level shifting and amplification allows the pump processor to examine minute details imposed on relatively large scale pressure signal waveforms with increased resolution.

7.7.15 Variable Level Shifter

The pump processor uses half of a dual DAC and an op amp to generate a variable offset voltage for the level shifting process. A -3.84 volt reference voltage for the DAC input is generated from the 5 volt reference voltage by another op amp. This allows the DAC to

generate a variable offset voltage between zero and 3.84 volts, in 15 millivolt increments. The offset voltage from the first op amp is subtracted from the single ended pressure signal by the second op amp.

7.7.16 Variable Gain Amplifier

The pump processor uses the other half of the dual DAC and an op amp to amplify the level shifted pressure signal by a variable amount. Since the DAC is inserted in the feedback path of the op amp instead of its input path, the gain is inversely proportional to the DAC setting. Thus, the gain can be varied from 256/255 to 256/1. The output of the variable gain amplifier is clamped by means of a diode/resistor matrix, to protect the A/D inside the pump processor from excessive voltages. Refer to 6.11 Pressure Transducer A/D offset Test.

7.7.17 Time of Day

The main board maintains the current time by means of a serial timekeeper integrated circuit with a separate 32.768K Hz crystal. The serial timekeeper counts seconds, minutes, hours, day, month, and year. The time-of-day select line, TOD, is generated and latched in the ASIC. It is controlled by bit four of the command byte that is located at address 2200 hex in the management processor's I/O space. The serial timekeeper is powered by VMEM, which is backed up with a 3 volt battery when VCC is not available.

7.7.18 Audible Alarms

7.7.18.1 Primary Alarm

Both primary and backup audible alarm circuits are provided on the main board. The primary alarm uses an external 8 ohm speaker. It is driven by a full bridge speaker driver integrated circuit which is fed by a chime generator circuit. The chime generator is built around an op amp which receives a software controlled volume control signal on its positive input terminal and a software controlled pitch signal on its negative input terminal. The pitch signal is a square wave transmitted from management processor port pin P15. The volume control signal is an exponentially decaying waveform derived from a 1.5 microfarad capacitor or a 10 microfarad capacitor, which are both connected to the positive terminal of the op amp through a diode array and a 100 K ohm input resistor. The 1.5 microfarad capacitor is used to generate short decay time volume control waveforms, for maximum chime effect. The 10 microfarad capacitor is used to generate longer decay time volume control waveforms, for a steady tone effect. The 1.5 microfarad capacitor is charged up to a software controlled initial value by management processor port pin P03. The 10 microfarad is charged up to a software controlled initial value by management processor port pin P04.

The speaker current is sensed by a series 0.1 ohm resistor and amplified by an op amp. The amplified speaker current signal is routed to a peak detector, consisting of series resistor, series diode, storage capacitor, and drain resistor. The peak detected speaker current signal is monitored by the management processor, via

an analog comparator input.

7.7.18.2 Backup Alarm

The backup alarm uses an onboard or external piezo sound generator with built in oscillator. The alarm is driven by a voltage doubler integrated circuit which receives input power from the VBKUP line. The backup alarm is turned on by the BKUPALARM signal from the power controller EPLD. See section 7.7.12.2 "Power Controller EPLD" for a description of the BKUPALARM signal. The BKUPALARM signal turns on FET, which completes the ground circuit for the voltage doubler and piezo sound generator. Since both the EPLD and the voltage doubler are powered by VBKUP, which is backed up with an onboard 4.8 volt battery, the backup alarm can continue to sound even if the instrument is unplugged and the main battery becomes discharged. This alarm can be turned off manually by touching the 2 contacts on the main PCB.

7.7.19 Overvoltage Detection Circuit

The Outlook overvoltage detection circuit utilizes a comparator to compare a scaled VCC against the 2.5 volt voltage reference. VCC is scaled by a voltage divider, and filtered by a 0.1 microfarad capacitor. When VCC reaches the trip point voltage, the comparator transmits a signal to the power fail input pin of the power supervisory circuit. The trip point is between 5.32 volts and 5.6 volts, with a nominal value of 5.46 volts. The power fail output pin and the reset output pin of the power supervisory circuit are connected together. Therefore, any positive voltage excursion on VCC with sufficient amplitude and duration will result in a board reset, which will cause the power controller EPLD to activate the backup alarm.

The overvoltage detection circuit is designed to filter out voltage spikes shorter than 4 milliseconds, and to generate a board reset signal for voltage spikes longer than 15 milliseconds. The 2.5 volt voltage reference, the power controller EPLD, and the backup alarm are powered by VBKUP. The comparator is powered by VCC, and is guaranteed to operate properly with input power from 3-15 volts.

7.7.20 Lead Acid Battery Charger System

The center of the battery charging system is a Unitrode UC3906 lead acid battery charger. The integrated circuits monitor and control both the output voltage and current of the charger through three separate charge states; a high current bulk charge state, a controlled over-charge and a float-charge, or standby, state.

When the battery voltage is very low, the charging current is limited to a low level until the battery reaches a specified voltage, preventing a high current charging if a battery cell is shorted. Once the battery voltage reaches the low voltage threshold, the charger will change into the high rate bulk charge state.

When the battery voltage reaches about 95% of the maximum overcharge voltage, the charger enters the over-charge state. The charge current will terminate when the charge voltage reaches the over-charge voltage.

If a load is applied to the battery and begins to discharge it, the charger will reset itself and begin the recharge cycle again after the battery voltage drops below the float level.

7.8 AIR-IN-LINE BOARD ASSY.

Air bubbles in the line are detected by means of the air-in-line block. The air-in-line block PCB contains two separate infrared LED/photosensor pairs, with current limiting LED resistors. One pair, the AIL pair, utilizes the different indices of refraction of air and liquids to detect air bubbles in the line. Its LED is energized by the AILLED signal generated on the main board. The output of this pair, AILSEN, is used by the main board to determine whether air is present in the line. In normal operation, AILSEN is high for air and low for liquids.

Another LED/photosensor pair, the TESTAIL pair, is used to test the operation of the AIL LED and photosensor. The TESTAIL LED is positioned to emit infrared light directly onto the AIL photosensor. The AIL output signal is high when the TESTAIL LED is on. The TESTAIL LED is energized by the TESTAILLED signal generated on the main board. The TESTAIL photosensor is positioned to detect infrared light emitted by the AIL LED. Its output signal, AILTESTSEN, is used by the main board to determine whether the AIL LED is working. AILTESTSEN is high when the AIL LED is on.

7.9 SYSTEM OPERATION

7.9.1 Power-up

The Outlook has two powered-up conditions. If the pump is off and unplugged, and then is plugged in, the power supply powers-up the system and the microprocessor programs start running. The management and pump processors initialize their internal memories, and wait for (POWER) on the key panel to be pressed. The pump processor continuously pulses the power supervisor circuit to prevent a watchdog reset. The management processor releases the reset line to the door, and the door processor turns on the single green AC LED indicator and waits for the first command from the management processor. The LCD contrast voltage is not turned on, so the LCD display remains blank. No messages are sent, and no other processes are active.

If the pump is not plugged in, and (POWER) is pressed, the power control circuitry, powered by the 4.8 volt backup battery, causes the main battery to be temporarily connected to the power supply, energizing the 5 volt switching regulator and generating Vcc to the whole system. This starts up the main board processors, which both detect that (POWER) is pressed. The EPLD, without software control, latches the main battery supply on. From this point, DC or AC power-up actions are the same.

At this point, the door processor is reset by the management processor, and the green AC LED indicator is turned on again. If the pump is actually running on the main battery, a later message from the management processor causes the LED indicators to switch to indicate BATT.

Both main board processors test internal and external RAM memories as well as the program EPROM contents. Any memory failure results in a system alarm. The management RAM is battery-backed by the 3 volt battery, and stores important data from when the pump was last turned off. This data is tested to be sure that its contents have not been altered. The management processor reads the contents of the time-of-day clock and alarms if the date or time data is invalid.

Messages start to be exchanged between management and pump processors. Periodic "I'm O.K." messages detect if either software ceases to work correctly. If this happens, the management and/or pump processor will sound an alarm.

The management processor sounds the chime sound of the audible alarm. The current drawn by the alarm driver is tested, and if the current read is too low, the backup alarm is turned on and a system alarm is generated. Refer to Alarm Code number 71 in section 8.3 "System Alarms."

The pump processor initializes the pumping mechanism circuits in the ASIC device. If the pump door is closed and the air-in-line block tube detector indicates that a set is in place, the restriction motor home position is located as well. If not, then this is done at RUN time.

The management processor sends commands to the door processor to initialize the LED display digits. Data displayed is determined by the data stored in management RAM and the settings from the Biomed Menu that concern data retention and start-up values. The LCD controller is initialized by management processor commands, and LCD contrast voltage and backlight are turned on. "I'm O.K." messages start to flow between door processor and management processor, and any failure in the exchange will result in either an audible alarm or an "Error" message on the LED displays.

Once all power-up testing has been completed and there are no alarms, the pump goes into the Hold state, and awaits operator action.

7.9.2 Hold State Operation

When the microprocessor is in the Hold state, the yellow Hold indicator is illuminated, and the Information Display indicates the time left and volume delivered values, along with the status, setup instructions or any relevant alarm messages. The Primary and Piggyback Rate and Volume To Be Delivered displays indicate the appropriate data as determined by the software power-up defaults, and previous saved data. If either Piggyback rate or Piggyback volume data is zero, then the Piggyback display remains blank. If not, it is illuminated at a reduced brightness to indicate that the Primary display digits would be

changed if the  keys are operated.

The management processor uses the state of the door and the air-in-line tubing detector to determine which prompt to show on the Information Display.

If (HOLD) has been pressed in response to an alarm condition then the appropriate alarm message will be shown at the bottom of the LCD Information Display until either (RUN) key is pressed.

At any time while in the Hold state, the rate and volume to be delivered values may be changed by pressing the keys below the display digits. If a key is pressed once, the audible alarm will beep once, and the corresponding digit will increase or decrease by one, or roll over or under if the maximum or minimum value has been reached. If a key is pressed and held, the corresponding digit will continue to change and the alarm will beep, at a rate of three times per second. Normally, either rate can be set from zero to 999.9 ml/hr, while the volume to be delivered can be set from zero to 9999.9 ml. Leading zeros are not displayed. The pump will not begin operation, however, if either the Rate or the Volume To Be Delivered Display of the current row is set to zero. If two keys are pressed simultaneously there will be no response.

In the Hold state, pressing (MENU) gives access to the Main and Alternate Menus and all of the features available there. Once the pump is running, only some Main and Alternate Menu choices are available.

During the Hold state, software internal tests are performed periodically and any problems that are detected generate an immediate alarm. After 20-30 seconds have transpired while in the Hold state without key presses, the word "Hold" is displayed in the unused VTBD channel of the LEDs. In addition, if the door is closed, a timer is activated which causes a "Hold Time Exceeded" alarm if the pump remains on hold without key presses for more than 3 minutes, unless Hold Extender option is being utilized. (See the Outlook Operator's Manual for an explanation of the Hold Extender option.) If the door is opened, the timer will be deactivated until the door is closed. Once the door is closed the timer is reset for another three minutes. Once the "Hold Time Exceeded" alarm is activated, (HOLD) must be pressed to silence the audible alarm, return the pump to the Hold state, and reset the timer for another three minutes.

If the door is open, the power can be turned on but all other key panel switches can only cause audible clicks. This is to prevent accidental data or status changes. If the door is open, the pump is on battery power and in the Hold state, the system will automatically turn off the device after approximately 20 minutes to conserve the battery.

7.9.3 Run State Operation

When either PRIMARY (RUN) or PIGGYBACK (RUN) is pressed, several tests are performed before fluid delivery begins. First, if either the Primary Rate or Volume To Be Delivered Display is set to zero, or either of the Piggyback Rate or Volume To Be Delivered Displays are zero and PIGGYBACK (RUN) was pressed, the appropriate zero display digit is illuminated, a warning message is displayed, the Alarm Indicator is illuminated, and the audible alarm sounds. If the door is opened after (RUN) is pressed, a "Door Open" alarm is generated. To clear the alarm close the door, press (HOLD), and press (RUN) again.

The management processor then sends delivery commands to the pump processor to begin pumping.

Before it begins, the pump processor checks the air-in-line block and flow clamp detector. If it indicates that a tube is not present, a "Flow Clamp Position" alarm is generated.

The pump processor moves the restriction motor to determine its home reference position. This position is the point where the restriction valve rests upon the channel in the cassette, and the optical yoke sensor beam detects the end of the restriction motor shaft. Any mechanical or electrical problem which prevents this will generate an alarm.

The pressure transducer is read by the pump processor. If this reading is above an acceptable limit, and the door is closed, the pump processor assumes that there is high pressure caused by the loading of a full cassette. The transfer solenoid is energized several times to attempt to let the pressure be relieved back upstream. If the reading (or pressure) cannot be relieved, an "Upstream Occlusion" alarm is generated. If there is a high transducer reading and the door is open, then a system alarm is generated.

If these tests are successful, the pump processor computes the various motor timing values required for accurate delivery and pumping begins.

Pumping is carried out in repeating cycles, at the rate selected by the operator. If the rate is 400.0 ml/hr or greater, the occlusion pressure limit is raised to 400 mmHg to compensate for dynamic pressures in the set. All events during the cycle are initiated by the pump processor. The initial conditions when the cycle starts are that the main motor is retracted to the point where delivery begins, the refill piston is fully forward, the transfer solenoid is not energized, so that the transfer valve is closed and the refill valve is open, and the restriction valve is closed.

The main motor is first moved forward at a high speed to pressurize the fluid in the delivery chamber. When the cassette is installed into the mechanism, and the door is shut, an undetermined amount of fluid is held within each of the two chambers. A full delivery chamber is required for proper pumping action, so that if the chamber does not come up to pressure in a certain number of main motor steps, the pump processor tries to fill the

chamber from the refill chamber. This is accomplished by stopping the main motor and actuating the transfer solenoid, which opens the transfer valve, and closes the inlet valve. Then, the main motor draws the petal module back, which simultaneously allows the refill piston to move forward, pushing fluid from the refill chamber into the delivery chamber. When the transfer solenoid is then released, allowing the inlet and refill valves to return to their original positions, more fluid will have been captured in the delivery chamber. Up to four such attempts are made to fill up the delivery chamber. If this does not fill the chamber, a "Bag Empty" alarm is generated, otherwise, the system is checked for leaks.

After a pause the pressure is checked and if it has dropped too far, implying that the cassette or valves are not properly seated, an alarm is generated.

The restriction motor opens the restriction valve while the transducer signal is monitored. At the point where the valve starts to open, the pressure in the delivery chamber drops, and this is when actual pumping begins. The main motor steps forward at a constant speed determined by the selected delivery rate, and the pump processor monitors the transducer signal while controlling the restriction motor, so that the internal pressure is maintained at a constant level as determined by the selected maximum occlusion pressure. If the internal pressure rises, the restriction valve is opened, and if it drops, the valve is closed. This is necessary to insure accurate fluid delivery - if the pressure in the chamber is the same at the end of pumping as it was at the start, a predictable amount (approximately 0.83 milliliters) of fluid will have been delivered. Different control methods are used at different delivery rates, but the results are the same over the range of rates and pressures. Note that the pressure in the tubing will only be at the patient's pressure, plus any dynamic pressures in the tubing caused by the fluid flow itself or other items that may be obstructing the fluid flow.

At the end of the cycle, the restriction valve is closed to prepare for refill, and the transfer solenoid is actuated. Since the refill piston was pulled back as the main motor moved forward, the refill chamber has been filled from the IV fluid container. As the main motor is retracted and the piston returns forward, this fluid is pushed into the delivery chamber for the next cycle. The main motor is pulled back far enough that the piston travels fully forward.

Several checks are made during pumping to assure proper delivery. First, if the main motor encoder does not see motor movement a system alarm is generated.

If the restriction optical yoke fails to sense the restriction valve closing when expected, a system alarm is generated.

If the air-in-line sensor detects air over a certain number of pumping steps, an "Air-In-Line" alarm is generated. Also during pumping, the air-in-line sensor pair is tested by an auxiliary transmitter/receiver pair, failure of which will generate an alarm. If during pumping the pressure in the delivery chamber reaches a preset limit (determined by the selected maximum pressure), pumping stops momentarily while the restriction valve is opened. If the pressure does not drop within a few seconds, an "Occlusion" alarm or warn-

ing is generated. In addition, if the pump repeatedly reaches the preset pressure, an "Occlusion" alarm or warning will be generated, even if the pressure is released each time.

If there is not enough fluid available to refill the delivery chamber, or there is a large amount of air collected in the delivery chamber, the start of the following cycle will not be successful, and a "Solution" alarm will be generated.

The pumping rate can be changed during the Run state by using the + - keys to change the rate in the Rate Display, and then pressing ENTER. If ENTER is not pressed within a few seconds, the audible alarm will beep and the Rate Display will revert to its previous setting. The new delivery rate does not actually change until ENTER is pressed. Once ENTER is pressed the pump will calculate the new delivery parameters and initiate the rate change immediately.

For safety and reliability during delivery, the management processor performs what is called a coprocessor function. It tracks the operation of the pump processor and if it determines that the pump processor is not delivering fluid properly, it stops the system and generates an alarm. This prevents a single software bug, damage or temporary data loss from causing an incorrect delivery.

7.9.4 Keep Vein Open State Operation

When the Primary Volume To Be Delivered Display decreases to zero, the pump enters the KVO state. The Alarm Indicator is turned on while the Run Indicator continues to operate. The audible alarm sounds periodically, and the Information Display displays the KVO message. The maximum pressure setting reverts to the preset value if it automatically was increased to compensate for 400 ml/hr or higher flow rates, and if the selected delivery rate is above 3.0 ml/hr, it is reduced to 3.0 ml/hr. The Volume Delivered value continues to be increased as fluid is delivered. This state will continue indefinitely, until either fluid runs out, giving a "Bag Empty" alarm, or HOLD is pressed to go into the Hold state. Once the instrument goes into the Hold state, the pump will not run again until the VTBD value has been set above zero (unless the automatic Piggyback Callback method is being used as described earlier).

7.9.5 Alarm State Operation

Whenever the microprocessor detects an alarm condition, the Alarm state begins immediately. If the pump is in the Run state when the alarm occurs, the main motor immediately retracts (as if it were the end of a pump cycle) and then stops. The Alarm Indicator is illuminated and the audible alarm chimes. At the same time, the Volume To Be Delivered and Rate Displays will flash an abbreviated alarm message, and the Information Display will display a message which indicates the cause of the alarm. The user will be given the option to display a screen suggesting steps to take to eliminate the problem. This alarm mode can continue since the NiCad backup battery on the main board will operate the

backup alarm if the pump's main battery fails.

When (HOLD) is pressed, the audible alarm is silenced and the system reverts to the Hold state. Once the cause of the alarm has been corrected, the infusion can be restarted by pressing (RUN). In the case of a few serious system alarms, which are indicated by the "Repair Instrument" alarm message, the instrument must be turned off and back on before (RUN) can be pressed.

In some cases where one or more of the processors fail or the battery is deeply discharged, the system might generate either a chiming or high-pitched tone which is the backup alarm, and (HOLD) does not shut it off. In this case, pressing (POWER) and possibly removing the AC power to shut off the pump will silence the alarm.

If the main PCB is removed while the backup alarm is still activated it can be deactivated by touching the two contacts on the front of the PCB.

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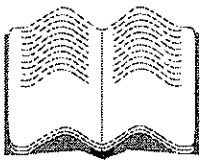
CHAPTER 8.0
PUMP HISTORY, ALARMS, & TROUBLESHOOTING



IN THIS CHAPTER YOU WILL LEARN:

- How to view the pump's operation and alarm histories.
- How to determine the software configuration of the pump.
- About the potential alarm conditions, their causes, and required follow-up actions.

8.1 ALARM AND OPERATION HISTORIES

The Alarm, Operation, and DoseGuard™ Alert History logs are the most useful tools available for troubleshooting the Outlook Pump. The unique feature of the logs is that each time an event is stored in the log, it is time and date stamped. The logs will each hold 255 entries (32 bytes each) which can be down-loaded to a PC as frequently as needed. The file size on the PC will be approximately 55 kilobytes once down-loaded. It is estimated that under normal use, the Operation log will store approximately one month's worth of information and the Alarm log will store approximately 3-4 months of information. The length of time it takes to fill the log depends upon how frequently the controls of the pump are manipulated.

Once the log is filled, the oldest event will be discarded and the new event will be appended to the end of the list, in a First In First Out (FIFO) fashion. A tremendous amount of information exists in the logs. Once familiar with the logs, they will become a valuable diagnostic and troubleshooting tool.

The Operation log holds all events, including alarms, alerts, and other user operations. It offers you the ability to view the use history of the device, thereby verifying that rates and volumes had indeed been entered as intended as well as determining the sequence of events that proceeded some particular alarm. When identifying the time of an event occurrence, first verify the time of day clock has been properly set by checking the "Review Time and Date" option in the Biomed Menu. If it has not, simply adjust it accordingly and add or subtract that amount of time from the log to determine the actual time of the event.

The Alarm log is similar to the Operation log in many ways, the primary difference being that it stores the last 255 alarms instead of operations and therefore will hold approximately 3-4 months of alarm history. The Alarm log is useful for giving a quick look at the alarm history versus having to wade through all of the user operations.

NOTE: When receiving a new pump or one which has been serviced, the logs will still have entries in them. There is no method to clear the logs of information. Since the device is tested for functionality prior to leaving the service facility or factory, these alarm entries will remain in the log.

If you download the logs on a regular basis and wish to save this information for future reference, a tremendous amount of disk space can be saved if you use a file compression utility on the files. Without compression you will only be able to store approximately 200 operation logs per 10 Megabytes of disk space. File compression can reduce the amount of disk space required by approximately 85%, from 10 Megabytes down to 1.5 Megabytes. Many varieties of compression utilities are available from your local software dealer or through shareware. Please keep in mind that a certain amount of risk is involved when you alter the files and B. Braun shall not be responsible or liable for the loss or corruption of data.

To receive the file onto your PC, you will need to obtain an Outlook WinDock kit (software, Biomed box, and cable) that interfaces with the Data Communications Port. The 9 pin male cable can be connected to any standard comm port. If you do not have a free 9 pin port, simply attach a 9 to 25 pin convertor. This will allow you to connect the link to 25 pin ports also. Most any PC communications package can be used to receive the pump's log information. The information can also be sent directly to a printer; in this case you will need to refer to the printer's manual for serial port configuration DIP switch settings. Since the information is sent at such a high BAUD rate, the speed of the printer will need to be fast and it will need to have a sizeable buffer, such as 32 Kilobytes. The entire log will be transmitted in approximately 90 seconds.

Communication settings: 9600 Baud, no parity, 8 data bits, 1 stop bit

8.1.1 Accessing Operation, DoseGuard™ Alert, and Alarm Histories

1. Enter the Biomed Options Menu (refer to 4.1).
2. Use the CURSOR to highlight "Check Alarm Log," "DoseGuard Alert Log,"or "Check Operation Log," then press ENTER.
3. Use the CURSOR to highlight "Pump Display" to display the log on the Information Screen of the pump, then press ENTER. Highlight "Communication Link," then press ENTER to send the log to a computer using the Outlook WinDock software.

NOTE: Refer to the Windock Operation Manual (951031) to learn how to use the capture Alarm, DoseGuard™ Alert, and Operation Histories using the Outlook WinDock software.

See the APPENDIX for an example of an Operation log.

8.2 CHECK CONFIGURATION OF SOFTWARE

This feature allows you to check the current software revisions in the device. It is recommended that you have this information available when communicating a problem to your customer service representative. A definition of the display is as follows:

MP = Management Processor,

PP = Pump Processor,

DP = Door Processor.

Each is followed by the present revision level. Each processor may have a different revision level.

1. Enter the Biomed Options Menu (refer to 4.1).
2. Use the 

to highlight "Check Configuration," then press ENTER.
3. When finished, press ENTER to return to the Biomed Menu.

8.3 SYSTEM ALARMS

The following table lists all alarms potentially generated in the Outlook software. Each alarm is identified with a number which may appear on the display during the alarm or immediately upon power up after a "SYSTEM" alarm.

Code	Alarm/ User Message	Probable Cause	Corrective Action
1	Container Is Empty/ Bag Empty	1. Fluid source is empty, or excessive air in cassette 2. Cassette not loaded properly. 3. Cassette failure. 4. Jammed refill piston. 5. Jammed inlet or transfer valves. 6. Solenoid jammed, out of adjustment or loosely mounted. 7. Mechanical failure of solenoid driving the transfer valve. 8. Petal module stuck or jammed. 9. Failure of solenoid driver circuitry on Main PCB. 10. Failure of the pressure transducer and/or its associated circuitry.	1. Re-fill the fluid source, or check cassette for air. 2. Reload the cassette (follow instructions inside door). 3. Inspect cassette for abnormalities, such as something besides fluid inside the pouches, etc. 4. Check for freedom of movement. Clean refill piston with warm water. 5. Check the inlet and transfer valves for freedom of movement by pressing on the valve tips with your finger. Clean if sticking. 6. Make sure the solenoid mounting screws are secure. Check the solenoid gap adjustment and inspect for evidence of failure such as discoloration from heat or squeaking operation. Make sure the Phillips screws used to attach the entire mechanism assembly to the bezel are secure. 7. Replace the Door/Bezel Assembly, see page 131. 8. Remove and clean petal module with warm water. 9. Replace the Main Circuit Board, see page 126. 10. Inspect the pressure transducer for damage. Replace Door/Bezel Assembly, see page 131.
2	Error Locating Restriction/Outlet Valve Closed Position/ Error	1. Optical sensor on restriction/outlet valve yoke failure or sensor is dirty. 2. Restriction/outlet valve is jammed. 3. Connector to restriction/outlet valve yoke sensor is loose or dislodged. 4. Restriction/outlet valve yoke out of adjustment. 5. Restriction motor failure. 6. Motor driver circuitry on Main PCB failure.	1. Clean the sensor surface. If problem continues, replace the Door/Bezel Assembly, see page 131. 2. Check the restriction/outlet valve for freedom of movement by pressing on the valve tips with your finger. Clean with warm water. 3. Reseat the restriction/outlet valve yoke connector. Check for broken wire at the connector. 4. Check the restriction/outlet valve yoke adjustment and adjust as necessary (see Section 6.12). 5. Replace the restriction motor or the Door/Bezel Assembly, see page 131. 6. Replace the Main Circuit Board, see page 126.
3	Initial Delivery Chamber Pressure Too High/ Error	1. Failure of pressure transducer. 2. Defective bezel assembly.	1. Inspect pressure transducer for damage. Test the pressure transducer (see Section 6.11). 2. Replace the Door/Bezel Assembly, see page 131.

Code	Alarm/ User Message	Probable Cause	Corrective Action
4	Main Motor Windings Are Bad/ Error	1. Main motor failure. 2. Main motor connection failure. 3. Main motor circuitry on the main PCB failure.	1. Check main motor connection. 2. Replace the Door/Bezel Assembly, see page 131. 3. Replace the Main Circuit Board, see page 126.
5	Maximum Initial Retraction Steps Exceeded/ Error	1. Main motor failure. 2. Main motor encoder assembly and/or sensor dirty, loose, or failed. 3. Main PCB failure.	1. Replace the Door/Bezel Assembly, see page 131. 2. Inspect the main motor encoder wheel for dust or other contaminant and clean with cleaner or air blast if necessary. The encoder wheel should be centered upon its sensor and rotate with moderate resistance. Return to position if necessary by sliding it into place. 3. Replace the Main Circuit Board, see page 126.
6	No More Refills Allowed/ Bag Empty	1. Fluid source is empty, or excessive air in cassette. 2. Cassette not loaded properly. 3. Cassette failure. 4. Jammed inlet or transfer valves. 5. Solenoid jammed, out of adjustment, or loosely mounted. 6. Stuck refill piston. 7. Mechanical failure of mechanism or connection through the interface PCB. 8. Failure of solenoid driver circuitry on Main PCB. 9. Failure of the pressure transducer and/or its associated circuitry. 10. Stuck or jammed petal module.	1. Re-fill the fluid source, or check cassette for air. 2. Reload the cassette (follow instructions inside door). 3. Inspect cassette for abnormalities, such as something besides fluid inside the pouches, etc. 4. Check the inlet and transfer valves for freedom of movement by pressing on the valve tips with your finger. Clean and or lubricate the valve shaft with silicon spray as needed. Do not spray the valve tips. 5. Make sure the solenoid mounting screws are secure. Check the solenoid adjustment and inspect for evidence of failure such as discoloration from heat or squeaking operation. Make sure the Phillips screws used to attach the entire mechanism assembly to the bezel are secure. 6. Clean piston area with warm water. 7. Replace the solenoid or the Door/Bezel Assembly, see page 131. 8. Replace the Main Circuit Board, see page 126. 9. Inspect the pressure transducer for damage. Replace the Door/Bezel Assembly, see page 131. 10. Remove and clean petal module with warm water.

Code	Alarm/ User Message	Probable Cause	Corrective Action
7	Outlet Valve Cannot Close/ Check Set	1. Cassette not loaded properly. 2. Cassette failure. 3. Jammed restriction/outlet valve. 4. Restriction/outlet valve yoke out of adjustment. 5. Optical sensor on restriction/outlet valve yoke failure or sensor surface is contaminated. 6. Restriction motor driver circuitry on Main PCB failure. 7. Restriction motor failure.	1. Reload the cassette (follow instructions inside door). 2. Inspect cassette for abnormalities, such as something besides fluid inside the pouches, etc. 3. Check the restriction/outlet valve for freedom of movement by pressing on the valve tips with your finger. 4. Check the restriction/outlet valve yoke adjustment (see Section 6.12). 5. Clean the optical sensor and check connections then retry operation. If this fails to correct the problem, replace the Door/Bezel Assembly, see page 131. 6. Replace the Main Circuit Board, see page 126. 7. Replace the restriction motor assembly.
8	Outlet Valve Cannot Open/ Error	1. Jammed restriction/outlet valve. 2. Restriction/outlet valve yoke out of adjustment. 3. Optical sensor on restriction/outlet valve yoke failure or sensor surface is contaminated. 4. Restriction Motor driver circuitry on Main PCB failure. 5. Restriction motor failure.	1. Check the restriction/outlet valve for freedom of movement by pressing on the valve tips with your finger. 2. Check the restriction/outlet valve yoke adjustment (see Section 6.12). 3. Clean the optical sensor and check connections, then retry operation. 4. Replace the Main Circuit Board, see page 126. 5. Replace the restriction motor or the Door/Bezel Assembly, see page 131.
9	Outlet Transfer Valve Leaking/ Check Set	1. Cassette not loaded properly. 2. Cassette failure. 3. Jammed restriction/outlet valve. 4. Restriction/outlet valve yoke out of adjustment. 5. Optical sensor on restriction/outlet valve yoke failure or sensor surface is contaminated. 6. Restriction motor driver circuitry on Main PCB failure. 7. Restriction motor failure. 8. Transfer valve leaking. 9. Worn transfer valve.	1. Reload the cassette (follow instructions inside door). 2. Inspect cassette for abnormalities, such as something besides fluid inside the pouches, etc. 3. Check the restriction/outlet valve for freedom of movement by pressing on the valve tips with your finger. 4. Check the restriction/outlet valve yoke adjustment (see Section 6.12). 5. Clean the optical sensor and check connections, then retry operation. If this fails to correct the problem, replace the Door/Bezel Assembly, see page 131. 6. Replace the Main Circuit Board, see page 126. 7. Replace restriction motor or the Door/Bezel Assembly, see page 131.

Code	Alarm/ User Message	Probable Cause	Corrective Action
10	Outlet Valve Motor Windings Bad/ Error	1. Restriction motor failure. 2. Restriction motor connection failure. 3. Restriction motor driver circuitry on main PCB failure.	1. Replace the restriction motor. 2. Check the restriction motor connection. 3. Replace the Door/Bezel Assembly, see page 131. 4. Replace the Main Circuit Board, see page 126.
11	Outlet Valve And Main Motor Windings Bad/ Error	1. Restriction motor connection failure. 2. Restriction motor failure. 3. Main motor connection failure. 4. Motor driver circuitry on main PCB failure.	1. Check the restriction motor connection. 2. Replace restriction motor. 3. Check main motor connection. 4. Replace the Main Circuit Board, see page 126.
12	Transfer Valve Leaking/ Check Set	1. Cassette not loaded properly. 2. Cassette failure. 3. Jammed transfer valve. 4. Solenoid jammed, out of adjustment or loosely mounted. 5. Mechanical failure of solenoid driving the transfer valve. 6. Failure of solenoid driver circuitry on Main PCB.	1. Reload the cassette (follow instructions inside door). 2. Inspect cassette for abnormalities, such as something besides fluid inside the pouches, etc. 3. Check the inlet and transfer valves for freedom of movement by pressing on the valve tips with your finger. Clean or lubricate the valve shaft with silicon spray as needed. Do not spray the valve tips. 4. Make sure the solenoid mounting screws are secure. Check the solenoid adjustment and inspect for evidence of failure such as discoloration from heat or squeaking operation. Make sure the Phillips screws used to attach the entire mechanism assembly to the bezel are secure. 5. Replace the Door/Bezel Assembly, see page 131. 6. Replace the Main Circuit Board, see page 126.

Code	Alarm/ User Message	Probable Cause	Corrective Action
14	Upstream Occlusion/ Occlusion	1. Tube obstruction proximal to the pump. 2. Fluid source is empty, or excessive air in cassette. 3. Cassette not loaded properly. 4. Cassette failure. 5. Damaged pressure transducer. 6. Jammed inlet or transfer valves. 7. Solenoid jammed, out of adjustment or loosely mounted. 8. Mechanical failure of solenoid driving the transfer valve, or failure of refill piston. 9. Failure of solenoid driver circuitry on Main PCB.	1. Check tubing between the fluid source and the pump. 2. Check the cassette for excessive air in the pouches. 3. Reload the cassette (follow instructions inside door). 4. Inspect cassette for abnormalities, such as something besides fluid inside the pouches, etc. 5. Inspect the pressure transducer for damage. ReplaceDoor/Bezel Assembly, see page 131. 6. Check the inlet and transfer valves for freedom of movement by pressing on the valve tips with your finger. 7. Make sure the solenoid mounting screws are secure. Check the solenoid adjustment and inspect for evidence of failure such as discoloration from heat or squeaking operation. Make sure the Phillips screws used to attach the entire mechanism assembly to the bezel are secure. 8. Replace the Door/Bezel Assembly, see page 131. 9. Replace the Main Circuit Board, see page 126.
15	Backfills Allowed Should Not Be 0/ Error	1. Software failure.	1. Retry operation and if error continues, replace the Main Circuit Board, see page 126.
16	Gross Cycle Timer Error/ Error	1. Software failure.	1. Retry operation and if error continues, replace the Main Circuit Board, see page 126.
17	Maximum Restriction/Outlet Valve Position Exceeded/ Error	1. Restriction/outlet valve yoke out of adjustment. 2. Restriction motor failure. 3. Optical sensor on restriction/outlet valve yoke failure or sensor surface is contaminated. 4. Restriction motor driver circuitry on Main PCB failure.	1. Check the restriction/outlet valve yoke adjustment (see Section 6.12). 2. Replace restriction motor or the Door/Bezel Assembly, see page 131. 3. Clean the optical sensor and check connections, then retry operation. If this fails to correct the problem, replace the Door/Bezel Assembly, see page 131. 4. Replace the Main Circuit Board, see page 126.

Code	Alarm/ User Message	Probable Cause	Corrective Action
19	Main Motor Slipped On Pressurization Step/ If On AC - Error If On DC - Plug AC	1. Low battery condition. 2. Main motor carriage driver needs lubrication or is loose. 3. Pressure transducer and/or associated circuitry failure. 4. Main motor failure. 5. Main motor encoder assembly and/or sensor dirty, loose or failed.	1. Plug the pump in and allow it to recharge before operating on battery. 2. Check for rotation of main motor and lubricate carriage driver with B. Braun approved silicon spray only, other lubricants will worsen the problem over time. If loose, replace carriage driver. 3. Inspect the pressure transducer for damage. Replace the Door/ Bezel Assembly, see page 131. 4. Replace the Door/Bezel Assembly, see page 131. 5. Inspect the main motor encoder wheel for dust or other contaminant and clean with cleaner or air blast if necessary. The encoder wheel should be centered upon its sensor and rotate with moderate resistance. Return to position if necessary by sliding it into place.
20	Main Motor Slipped On Retraction Step/ Error	1. Low battery condition. 2. Main motor carriage driver needs lubrication or is loose. 3. Pressure transducer and/or associated circuitry failure. 4. Main motor failure. 5. Main motor encoder assembly and/or sensor dirty, loose or failed.	1. Plug the pump in and allow it to recharge before operating on battery. 2. Check for rotation of main motor and lubricate carriage driver with B. Braun approved silicon spray only, other lubricants will worsen the problem over time. If loose, replace carriage driver. 3. Inspect the pressure transducer for damage. 4. Replace the Door/Bezel Assembly, see page 131. 5. Inspect the main motor encoder wheel for dust or other contaminant and clean with cleaner or air blast if necessary. The encoder wheel should be centered upon its sensor and rotate with moderate resistance. Return to position if necessary by sliding it into place.

Code	Alarm/ User Message	Probable Cause	Corrective Action
21	Main Motor Slipped On Delivery Step/ If On AC - Error If On DC - Plug AC	1. Low battery condition. 2. Main motor carriage driver needs lubrication or is loose. 3. Pressure transducer and/or associated circuitry failure. 4. Main motor failure. 5. Main motor encoder assembly and/or sensor dirty, loose or failed.	1. Plug the pump in and allow it to recharge before operating on battery. 2. Check for rotation of main motor and lubricate carriage driver with B. Braun approved silicon spray only, other lubricants will worsen the problem over time. If loose, replace carriage driver. 3. Inspect the pressure transducer for damage. 4. Replace the Door/Bezel Assembly, see page 131. 5. Inspect the main motor encoder wheel for dust or other contaminant and clean with cleaner or air blast if necessary. The encoder wheel should be centered upon its sensor and rotate with moderate resistance. Return to position if necessary by sliding it into place.
22	Air In Line/ Air in Line	1. Air is trapped in the tubing. 2. The Air-In-Line sensors are contaminated. 3. Air-In-Line block failure.	1. Remove air from the tubing and continue operation. 2. Inspect the tubing channel in the Air-In-Line block for contamination or fluid and clean with a cotton swab and rubbing alcohol if necessary. 3. Replace the Air-In-Line block assembly.
23	Pump Processor Software Error/ Error	1. Pump processor has malfunctioned 2. Pressure transducer and/or associated circuitry damaged or failed.	1. Replace the Main Circuit Board, see page 126. 2. Inspect the pressure transducer for damage. 3. Replace the Door/Bezel Assembly, see page 131.
24	Downstream Occlusion/ Occlusion	1. Tube obstruction distal to the pump. 2. Restriction/outlet valve sticking or out of adjustment. 3. Restriction motor failure, or mechanism interface PCB. 4. Pressure transducer and/or associated circuitry damaged or failed. 5. Main PCB failure.	1. Check tubing for a closed clamp or kinks in the tubing between the pump and the patient and continue operation. 2. Check the restriction/outlet valve for freedom of movement by pressing on the valve tip with your finger, valve should depress inward against spring resistance. Check the restriction/outlet valve adjustment. 3. Replace restriction motor or the Door/Bezel Assembly, see page 131. 4. Inspect the pressure transducer for damage. Replace the Door/ Bezel Assembly, see page 131. 5. Replace the Main Circuit Board, see page 126.

Code	Alarm/ User Message	Probable Cause	Corrective Action
25	Analog To Digital Offset Value Out Of Specification/ Error	1. Cassette damaged. 2. Pressure transducer and/or associated circuitry failure. 3. Main PCB failure.	1. Replace cassette and retry operation. 2. Inspect the pressure transducer for damage. Test pressure transducer (see Section 6.11). 3. Inspect the petal module for fluid or any obstruction.
26	Utl Message Checksum Error/ Error	1. Internal software communication failure.	1. Retry operation and if error continues, replace the Main Circuit Board, see page 126.
27	Utl Message Invalid Length/ Error	1. Internal software communication failure.	1. Retry operation and if error continues, replace the Main Circuit Board, see page 126.
28	Utl Message Contains Invalid Destination Address/ Error	1. Internal software communication failure.	1. Retry operation and if error continues, replace the Main Circuit Board, see page 126.
29	Utl Message Queue Overrun/ Error	1. Internal software communication failure.	1. Retry operation and if error continues, replace the Main Circuit Board, see page 126.
30	Over Temperature Alarm/ Error	1. Temperature sensor indicates an over temperature condition. 2. Temperature sensor failure on the Main PCB, or other Main PCB failure. 3. Fan failure.	1. Verify the fan inlet on the rear of the pump is not obstructed. 2. Replace the Main Circuit Board, see page 126. 3. Apply power to the fan and replace if it will not operate.
31	Semaphore ID Not Valid/ Error	1. Internal software communication failure.	1. Retry operation and if error continues, replace the Main Circuit Board, see page 126.
32	Semaphore Queue Full/ Error	1. Internal software failure.	1. Retry operation and if error continues, replace the Main Circuit Board, see page 126.
33	Too Many "Shut Down" Messages/ Error	1. Internal software communication failure.	1. Retry operation and if error continues, replace the Main Circuit Board, see page 126.
34	Too Many "Start Delivery Messages"/ Error	1. Internal software communication failure.	1. Retry operation and if error continues, replace the Main Circuit Board, see page 126.

Code	Alarm/ User Message	Probable Cause	Corrective Action
35	Not Ready To Start Delivery/ Error	1. Internal software communication failure.	1. Retry operation and if error continues, replace the Main Circuit Board, see page 126.
36	Too Many "Start Ramp Delivery" Messages/ Error	1. Internal software communication failure.	1. Retry operation and if error continues, replace the Main Circuit Board, see page 126.
37	Too Many "Enter KVO" Messages/ Error	1. Internal software communication failure.	1. Retry operation and if error continues, replace theMain Circuit Board, see page 126.
38	Total Volume Not Yet Delivered/ Error	1. Internal software communication failure.	1. Retry operation and if error continues, replace the Main Circuit Board, see page 126.
39	Not Ready For KVO/ Error	1. Internal software communication failure.	1. Retry operation and if error continues, replace the Main Circuit Board, see page 126.
42	Invalid Message Type Received/ Error	1. Unexpected acknowledgement message when powering down.	1. Retry operation and if error continues, replace the Main Circuit Board, see page 126.
43	Door Open While Pump Operating/ Door Open	1. Door was opened during fluid delivery. 2. Door sensor failure. 3. Door magnet failure.	1. Verify that the pump door is securely closed. Restart operation. 2. Replace the Door/Bezel Assembly, see page 131. 3. Replace the door lever.
44	DMA (Memory Transfer) Test Failure/ Error	1. Direct Memory test failed.	1. Retry operation and if the error continues, replace the Main Circuit Board, see page 126.
45	RAM (Memory) Test Failure/ Error	1. Random Access memory test failed.	1. Retry operation and if error continues, replace the Main Circuit Board, see page 126.
47	Invalid PRAM (Protected Memory) Element Operation/ Error	1. PRAM element size is zero or there are no PRAM elements checked out.	1. Retry operation and if error continues, replace the Main Circuit Board, see page 126.

Code	Alarm/ User Message	Probable Cause	Corrective Action
48	No Primary Rate/ 0.0 Flashing	1. PRIMARY RUN Key was pressed with a rate of zero.	1. Enter a valid rate and restart operation.
49	No Primary Volume/ 0.0 Flashing	1. PRIMARY RUN Key was pressed with a volume to be delivered of zero.	1. Enter a valid volume to be delivered and restart operation.
50	No Piggyback Rate/ 0.0 Flashing	1. PIGGYBACK RUN Key was pressed with a rate of zero.	1. Either enter a valid piggyback rate, or press the PRIMARY RUN Key.
51	No Piggyback Volume/ 0.0 Flashing	1. PIGGYBACK RUN Key was pressed with a volume to be delivered of zero.	1. Either enter a valid piggyback volume to be delivered, or press the PRIMARY RUN Key.
52	Hold Time Exceeded/ Hold	1. Pump has remained in the HOLD state with door closed for too long.	1. Resume operation or press the HOLD Key again.
53	Invalid Op Log Event/ SYS Err	1. Internal software communication failure.	1. Retry operation and if error continues, reseat or replace the EPROMs. 2. Replace Main PCB.
54	Bad Light Emitting Diode (LED)/ Error	1. An LED on the front panel is failing to draw current, or is drawing current when it should not.	1. Replace the LCD PCB.
55	Bad Parity/ Error	1. Bad incoming parity on door processor message.	1. Reseat the door connector on the mechanism interface board. 2. Check grounding clips on each end of door cable. Check copper grounding springs on the case bottom and mechanism. 3. Replace the LCD PCB and check all cable connections inside the door. 4. Replace the Main Circuit Board, see page 126.
56	Invalid Message Command/ Error	1. Invalid incoming command on door processor message.	1. Reseat the door connector on the mechanism interface board. 2. Check grounding clips on each end of door cable. Check copper grounding springs on the case bottom and mechanism. 3. Check all cable connections inside the door. 4. Retry operation and if error continues, replace the Main Circuit Board, see page 126.

Code	Alarm/ User Message	Probable Cause	Corrective Action
57	Invalid Message Digit/ Error	1. Input set digit position greater than four on door processor message.	1. Reseat the door connector on the mechanism interface board. 2. Check grounding clips on each end of door cable. Check copper grounding springs on the case bottom and mechanism. 3. Replace the LCD PCB and check all cable connections inside the door. 4. Replace the Main Circuit Board, see page 126.
58	Initial bit not set on Door Processor message/ SYS Err	1. Faulty door connector on mechanism interface PCB. 2. Faulty ground shielding on cosmetic bezel. 3. Faulty LED display PCB. 4. Faulty main processor (on the Main PCB).	1. Reseat the door connector on the mechanism interface board. 2. Check grounding clips on each end of door cable. Check copper grounding springs on the case bottom and mechanism. 3. Replace the LED display PCB and check all cable connections inside the door. 4. Replace the Main PCB.
59	No Watchdog Confirmation/ Error	1. Check commands from door processor not received in six seconds.	1. Faulty door connector on mechanism interface PCB. 2. Check grounding clips on each end of door cable. Check copper grounding springs on the case bottom and mechanism. 3. Faulty LCD PCB. 4. Faulty main processor (on the Main PCB). Replace the Main Circuit Board, see page 126.
60	Stack Error/ Error	1. Stack overflow on door processor.	1. Reseat the door connector on the mechanism interface board. 2. Check grounding clips on each end of door cable. Check copper grounding springs on the case bottom and mechanism. 3. Replace the LCD PCB and check all cable connections inside the door. 4. Replace the Main Circuit Board, see page 126.
61	Invalid group in Door Processor message/ SYS Err	1. Faulty door connector on mechanism interface PCB. 2. Faulty ground shielding on cosmetic bezel. 3. Faulty LED display PCB. 4. Faulty main processor (on the Main PCB).	1. Reseat the door connector on the mechanism interface board. 2. Check grounding clips on each end of door cable. Check copper grounding springs on the case bottom and mechanism. 3. Replace the LED display PCB and check all cable connections inside the door. 4. Replace the Main PCB.

Code	Alarm/ User Message	Probable Cause	Corrective Action
62	Message Parity Error/ Error	1. Parity bit error between door and OPM.	1. Reseat the door connector on the mechanism interface board. 2. Check grounding clips on each end of door cable. Check copper grounding springs on the case bottom and mechanism. 3. Replace the LCD PCB and check all cable connections inside the door. 4. Replace the Main Circuit Board, see page 126.
63	Direction Bit Error/ Error	1. Direction bit wrong in byte of message.	1. Reseat the door connector on the mechanism interface board. 2. Check grounding clips on each end of door cable. Check copper grounding springs on the case bottom and mechanism. 3. Replace the LCD PCB and check all cable connections inside the door. 4. Replace the Main Circuit Board, see page 126.
64	Unknown Door Command/ Error	1. Unknown door command.	1. Reseat the door connector on the mechanism interface board. 2. Check grounding clips on each end of door cable. Check copper grounding springs on the case bottom and mechanism. 3. Replace the LCD PCB and check all cable connections inside the door. 4. Replace the Main Circuit Board, see page 126.
65	Door Message Queue Full/ Error	1. Not enough room in queue for message from door processor.	1. Reseat the door connector on the mechanism interface board. 2. Check grounding clips on each end of door cable. Check copper grounding springs on the case bottom and mechanism. 3. Replace the LCD PCB and check all cable connections inside the door. 4. Replace the Main Circuit Board, see page 126.
66	Invalid Door State/ Error	1. Unknown software state of door processor.	1. Reseat the door connector on the mechanism interface board. 2. Check grounding clips on each end of door cable. Check copper grounding springs on the case bottom and mechanism. 3. Replace the LCD PCB and check all cable connections inside the door. 4. Replace the Main Circuit Board, see page 126.

Code	Alarm/ User Message	Probable Cause	Corrective Action
67	Timer Interrupt Test Failure/ Error	1. No timer interrupt.	1. Reseat the door connector on the mechanism interface board. 2. Check grounding clips on each end of door cable. Check copper grounding springs on the case bottom and mechanism. 3. Replace the LCD PCB and check all cable connections inside the door. 4. Replace the Main Circuit Board, see page 126.
68	Pump Communication Failure/ Error	1. No pump startup message received.	1. Reseat the door connector on the mechanism interface board. 2. Check grounding clips on each end of door cable. Check copper grounding springs on the case bottom and mechanism. 3. Replace the LCD PCB and check all cable connections inside the door. 4. Replace the Main Circuit Board, see page 126.
69	Door Communication Failure/ Error	1. No door configuration message received.	1. Reseat the door connector on the mechanism interface board. 2. Check grounding clips on each end of door cable. Check copper grounding springs on the case bottom and mechanism. 3. Replace the LCD PCB and check all cable connections inside the door. 4. Replace the Main Circuit Board, see page 126.
70	System Initialization: Pump Rx Time-out/ SYS Err	1. Internal software communication failure.	1. Retry operation and if error continues, reseat or replace the EPROMs. 2. Replace Main PCB.
71	Primary Alarm Failure/ Error	1. Speaker malfunction.	1. Reseat the connector and if the problem continues, replace the speaker assembly or speaker/fan assembly. 2. Replace the Main Circuit Board, see page 126.
72	Pump Processor Test Message Failure/ Error	1. Test message not received from pump processor.	1. Retry operation and if error continues, replace the Main Circuit Board, see page 126.

Code	Alarm/ User Message	Probable Cause	Corrective Action
73	Door Processor Test Message Failure/ Error	1. Test message not received from door processor.	1. Reseat the door connector on the mechanism interface board. 2. Check grounding clips on each end of door cable. Check copper grounding springs on the case bottom and mechanism. 3. Replace the LCD PCB and check all cable connections inside the door. 4. Replace the Main Circuit Board, see page 126.
74	Main Processor OK message not received/ SYS Err	1. Internal software communication failure.	1. Retry operation and if error continues, then replace the Main PCB or return the pump for service.
75	PRAM (Protected Memory) Failure/ Error	1. Check between protected RAM and image RAM failed.	1. This is normal and expected when the EPROMs are changed. Cycle the pump off then on again. 2. Test 3V lithium battery with a voltmeter and the device turned off and unplugged. Replace if less than 2.9V DC. 3. Replace the Main Circuit Board, see page 126. 4. All devices returned to Service Center will be set to factory defaults.
76	Battery very low/ USE AC	1. Battery charge is nearly depleted. 2. Damaged battery. 3. Main PCB failure.	1. Plug the pump in and allow it to recharge. Then perform a battery capacity check. 2. Remove battery and inspect for obvious damage. Even if no damage is visible, the battery may still be bad. Charge and test. 3. Replace the Main PCB.
77	Dose Menu Error/ SYS Err	1. Internal software communication failure.	1. Retry operation and if error continues, reseat or replace the EPROMs. 2. Replace Main PCB.
78	Send Door Processor Send Message Failure/ Error	1. Buffer test failed or proper mailbox test failed.	1. Retry operation and if error continues, replace theMain Circuit Board, see page 126 or return the pump for service. 2. Reseat the connector and if the problem continues, replace the LCD PCB assembly.
79	Test Air in Line detector malfunction/ SYS Err	1. Failure of the test Air-In-Line sensors. 2. Failure of port input pin on the 80C537 microprocessor on the main board.	1. Check Air-In-Line cable for proper connection. 2. Check the Air-In-Line PCB for cold solder joint or fluid. 3. Replace the Air-In-Line block. 4. Replace the Main PCB.

Code	Alarm/ User Message	Probable Cause	Corrective Action
80	Main Air in Line detector malfunction/ SYS Err	1. Failure of the main Air-In-Line sensors. 2. Failure of port input pin on the 80C537 microprocessor on the main board.	1. Clean the Air-In-Line detector PCB and retry operation if problem persists replace the Air-In-Line block. 2. Replace the Main PCB.
81	Main CRC Error/ Error	1. CRC check on domain buffer failed.	1. Retry operation and if error continues, replace the Main Circuit Board, see page 126.
82	Message Invalid Length/ Error	1. Received message is longer than user buffer.	1. Retry operation and if error continues, replace the Main Circuit Board, see page 126.
83	Message Invalid Destination/ Error	1. Invalid message domain address.	1. Retry operation and if error continues, replace the Main Circuit Board, see page 126.
84	Message Queue Overrun/ Error	1. Queue buffer overflow.	1. Retry operation and if error continues, replace the Main Circuit Board, see page 126.
85	Cassette Installation/ Check Set	1. The set is improperly positioned when the pump enters the Run state.	1. Install a set in the pump prior to activating the RUN Key. 2. Re-seat the set in the pump.
86	Time Of Day (TOD) Time Invalid/ Error	1. Problem with time of day setting.	1. 3 V lithium battery (disc shaped) discharged. Test with a voltmeter with device turned off and unplugged. Replace if less than 2.9 V. 2. Replace the Main Circuit Board, see page 126.
87	Time Of Day Initialization Failure/ Error	1. Time of Day clock not running.	1. Replace the Main Circuit Board, see page 126, or return the pump for service. 2. Replace the power supply.
89	Pump Processor receive interrupt service routine contains invalid destination address/ SYS Err	1. Internal software communication failure.	1. Retry operation and if error continues, reseat or replace the EPROMs. 2. Replace Main PCB.
90	Pump Processor receive character not synchronized/ SYS Err	1. Internal software communication failure.	1. Retry operation and if error continues, reseat or replace the EPROMs. 2. Replace Main PCB.

Code	Alarm/ User Message	Probable Cause	Corrective Action
91	Bad EPROM Checksum/ Error	1. ROM checksum does not equal calculated checksum.	1. Retry operation and if error continues, replace the Main Circuit Board, see page 126.
92	Start up message failure/ SYS Err	1. Internal software communication failure.	1. Retry operation and if error continues, reseat or replace the EPROMs. 2. Replace Main PCB.
93	System Integrity Check: Pump Processor bad EPROM checksum/ SYS Err	1. Internal software communication failure. 2. Failure of the Pump Processor or ACTEL ICs.	1. Retry operation and if error continues, reseat or replace the EPROMs. 2. Replace Main PCB.
94	Invalid Program Sequence/ Error	1. A block sequence number is used to determine if any domain has executed out of a sequence. Prior to a domain being called, a sequence number is retrieved. This alarm occurs when the sequence number is invalid.	1. Retry operation and if error continues, replace the Main Circuit Board, see page 126.
95	System Integrity Check: Pump Processor invalid program sequence/ SYS Err	1. Internal software communication failure.	1. Retry operation and if error continues, reseat or replace the EPROMs. 2. Replace Main PCB.
96	Stack Overflow/ Error	1. Stack overflowed at either the top or bottom.	1. Retry operation and if error continues, replace the Main Circuit Board, see page 126.
97	System Integrity Check: Pump Processor stack overflow/ SYS Err	1. Internal software communication failure.	1. Retry operation and if error continues, reseat or replace the EPROMs. 2. Replace Main PCB.
98	Invalid Special Function Register State/ Error	1. One of the special function registers has failed.	1. Retry operation and if error continues, replace the Main Circuit Board, see page 126.
99	System Integrity Check: Pump Processor Invalid Special Function Register state/ SYS Err	1. Internal software communication failure.	1. Retry operation and if error continues, reseat or replace the EPROMs. 2. Replace Main PCB.

Code	Alarm/ User Message	Probable Cause	Corrective Action
100	Unexpected Interrupt/ Error	1. An unexpected interrupt has occurred.	1. Retry operation and if error continues, replace the Main Circuit Board, see page 126.
101	Stuck Key/ Error	1. A repeating key has not responded in twenty seconds.	1. Replace the key panel. 2. Reseat the connector and if the problem continues, replace the LCD PCB. 3. Replace the Main Circuit Board, see page 126.
102	Coprocessor enter KVO time-out/ SYS Err	1. Failure to enter KVO within specified time limit.	1. Retry operation and if error continues, reseat or replace the EPROMs. 2. Replace main PCB.
103	Start Delivery Time-out Error/ Error	1. Time-out exceeded.	1. Retry operation and if error continues, replace the Main Circuit Board, see page 126.
104	Coprocessor parameters change time-out/ SYS Err	1. Internal software communication failure.	1. Retry operation and if error continues, reseat or replace the EPROMs. 2. Replace Main PCB.
105	Shutdown Time-out Error/ Error	1. Time-out exceeded.	1. Retry operation and if error continues, replace the Main Circuit Board, see page 126.
106	Start Ramp Time-out Error/ Error	1. Time-out exceeded.	1. Retry operation and if error continues, replace the Main Circuit Board, see page 126.
108	Over Infusion Time-out Error/ Error	1. Time-out exceeded.	1. Inspect the main motor encoder wheel and sensor for dust or other contamination or damage. Clean if necessary. 2. Replace the Door/Bezel Assembly, see page 131. 3. Replace the Main Circuit Board, see page 126.
110	Under Infusion Time-out Error/ Error	1. Time-out exceeded.	1. Inspect the main motor encoder wheel and sensor for dust or other contamination or damage. Clean if necessary. 2. Replace the Main Circuit Board, see page 126.
111	Coprocessor rate ramped time-out/ SYS Err	1. Internal software communication failure.	1. Retry operation and if error continues, reseat or replace the EPROMs. 2. Replace Main PCB.

Code	Alarm/ User Message	Probable Cause	Corrective Action
112	Air In Line Test Time-out Error/ Error	1. Time-out exceeded.	1. Remove the air and clean the sensor with alcohol and a cotton swab. 2. Replace the Air-In-Line block assembly. 3. Replace theMain Circuit Board, see page 126.
113	Air In Line/ Air in Line	1. Air in Line detector senses an excessive amount of air during Run state.	1. Remove the air and clean the sensor with alcohol and a cotton swab. 2. Replace the Air-In-Line block assembly. 3. Replace the Main Circuit Board, see page 126.
114	Solenoid Test Time-out Error/ Error	1. Time-out exceeded.	1. Check for good connection between the Main PCB and mechanism interface board then replace the Main Circuit Board, see page 126 if the connection is OK. 2. Replace the solenoid or the Door/ Bezel Assembly, see page 131.
115	Main Backward Test Time-out Error/ Error	1. Time-out exceeded.	1. Check for good connection between the Main PCB and mechanism interface board then replace the Main Circuit Board, see page 126 if the connection is OK.
116	Main Forward Test Time-out Error/ Error	1. Time-out exceeded.	1. Inspect the main motor encoder wheel for dust or other contaminant and clean with cleaner or air blast if necessary. The encoder wheel should be centered upon its sensor and rotate with moderate resistance. Return to position if necessary by sliding it into place. 2. Check for good connection between the Main PCB and mechanism interface board then replace the Main Circuit Board, see page 126, if the connection is OK. 3. Inspect the pressure transducer for damage.
117	Outlet Closed Test Time-out Error/ Error	1. Time-out exceeded.	1. Check for good connection between the Main PCB and mechanism interface board then replace the Main Circuit Board, see page 126, if the connection is OK.

Code	Alarm/ User Message	Probable Cause	Corrective Action
118	Stepping Fast Time-out Error/ Error	1. Time-out exceeded.	1. Inspect the main motor encoder wheel for dust or other contaminant and clean with cleaner or air blast if necessary. The encoder wheel should be centered upon its sensor and rotate with moderate resistance. Return to position if necessary by sliding it into place. 2. Check for good connection between the Main PCB and mechanism interface board then replace the Main Circuit Board, see page 126, if the connection is OK. 3. Replace the Mechanism Interface PCB. 4. Inspect the pressure transducer for damage.
119	Stepping Slow Test Time-out Error/ Error	1. Time-out exceeded.	1. Inspect the main motor encoder wheel for dust or other contaminant and clean with cleaner or air blast if necessary. The encoder wheel should be centered upon its sensor and rotate with moderate resistance. Return to position if necessary by sliding it into place. 2. Check for good connection between the Main PCB and mechanism interface board then replace the Main Circuit Board, see page 126, if the connection is OK. 3. Replace the Mechanism Interface PCB.
120	Coprocessor main motor not stepping/ SYS Err	1. Internal software communication failure.	1. Retry operation and if error continues, reseat or replace the EPROMs. 2. Replace Main PCB.
121	Coprocessor restriction motor not stepping/ SYS Err	1. Internal software communication failure.	1. Retry operation and if error continues, reseat or replace the EPROMs. 2. Replace Main PCB.
122	No Logical Interrupt Time-out Error Error	1. Time-out exceeded.	1. Check for good connection between the Main PCB and mechanism interface board then replace the Main Circuit Board, see page 126, if the connection is OK.

Code	Alarm/ User Message	Probable Cause	Corrective Action
123	Power Glitch During Delivery/ If On AC - Error If On DC - Plug AC	1. Power state is OFF during delivery.	1. This is normal and expected when the pump is allowed to infuse until the emergency backup alarm comes on. Plug the pump in and allow it to recharge. Then perform a battery capacity check. 2. Check Fuse 2 for continuity. 3. Remove battery and inspect for obvious damage. Even if no damage is visible the battery may still be bad. Replace and retest. 4. Replace the Main Circuit Board, see page 126.
124	Receive Message Buffer Overrun/ Error	1. Receive buffer size exceeded.	1. Retry operation and if error continues, replace the Main Circuit Board, see page 126.
126	AD offset not zero/ SYS Err	1. Internal software communication failure.	1. Retry operation and if error continues, reseat or replace the EPROMs. 2. Replace Main PCB.
127	Downstream Occlusion/ Occlusion	1. The operating pressure necessary to initiate or maintain the fluid flow exceeds the occlusion pressure limit during Run state.	1. Check for obstruction in the tubing. Retry operation and if error continues, inspect the pressure transducer for damage. 2. Replace the Main Circuit Board, see page 126.
128	No Ambient Light Message/ Error	1. Ambient light message not received.	1. Retry operation and if error continues, replace the LCD PCB. 2. Replace the Main Circuit Board, see page 126.
129	Software Error/ Error	1. Generic software logic error.	1. Retry operation and if error continues, replace the Main Circuit Board, see page 126.
130	Over Rate Test Time-out Error/ Error	1. Time-out exceeded.	1. Retry operation and if error continues, replace the Main Circuit Board, see page 126.
131	Under Rate Test Time-out Error/ Error	1. Time-out exceeded.	1. Retry operation and if error continues, replace the Main Circuit Board, see page 126.
132	Invalid Rate Test Time-out Error/ Error	1. Time-out exceeded.	1. Retry operation and if error continues, replace the Main Circuit Board, see page 126.
133	Next Delivery Step Test Time-out Error/ Error	1. Time-out exceeded.	1. Replace the Main Circuit Board, see page 126. 2. Replace the Door/Bezel Assembly, see page 131.

Code	Alarm/ User Message	Probable Cause	Corrective Action
134	Flow Clip/ See Help	1. The pump detects a Flow Clip failure when the Run key is pressed.	1. Verify that the set tubing is properly installed in the pump. 2. Verify proper tubing is being used. 3. Allow to dry then retry. If reoccurs, then replace the flow clip receptacle assembly. 4. Replace the Main Circuit Board, see page 126.
135	Main motor slip during forward non- pressurization step/ If on AC - SYS Err If on DC - PLUG AC	1. Low battery condition. 2. PCB has a poor connection.Black, negative sensor wire con-necting the battery to the Main PCB has a poor connection. 3. The main motor encoder wheel and sensor are contaminated or damaged. 4. Main motor failure. 5. Main PCB failure.	1. Plug the pump in and allow it to recharge. 2. Verify continuity between the main battery ground wires and the Main PCB. Break may be hidden by shrink wrap at the battery connection side. Resolder or replace wires if needed. 3. Inspect the main motor encoder wheel for dust or other contaminant and clean with cleaner or air blast if necessary. Encoder wheel should be centered on its sensor and should rotate with moderate resistance. If jammed, it may need some force to rotate free. Return to position if necessary by sliding it into place. 4. Replace the half door/bezel assembly. 5. Replace the Main PCB.
136	Bad LCD/ LCD Error	1. Unable to transfer or clear direct memory access blocks in LCD RAM.	1. Replace the LCD PCB. 2. Retry operation and if error continues, replace the Main Circuit Board, see page 126 or return the pump for service.
137	Optical Yoke adjustment measurement out of specification/ SYS Err	1. Restriction/outlet valve yoke sticking or out of adjustment. 2. Faulty restriction motor in mechanism. 3. Faulty motor drive circuitry on Main PCB	1. Check the restriction/outlet valve for freedom of movement by pressing on the valve tip with your finger, valve should depress inward against spring resistance. Check the restriction/ outlet valve yoke adjustment. 2. Replace the restriction motor or half door/bezel assembly. 3. Replace the Main PCB.

Code	Alarm/ User Message	Probable Cause	Corrective Action
138	Unexpected Back Alarm/ Error	1. Unexplained back alarm has occurred.	1. Check Fuse 2 for continuity . Check all connections to Main PCB. 2. Plug the pump in and allow it to recharge. Then perform a battery capacity check. 3. Remove battery and inspect for obvious damage. Even if no damage is visible, the battery may still be bad. Replace and retest. 4. Replace the Main Circuit Board, see page 126.
139	Batteries Improperly/Connected/ SYS Err	1. Batteries are not properly connected. 2. Low battery condition. 3. Damaged battery. 4. Main PCB failure.	1. Verify all batteries have good connections. 2. Plug the pump in and allow it to recharge. Then perform a battery capacity check. 3. Remove battery and inspect for obvious damage. Even if no damage is visible, the battery may still be bad. Replace and retest. 4. Replace the Main Circuit Board, see page 126.
140	Battery sense wire broken/ SYS Err	1. Pump is on DC operation and battery voltage reads less than main voltage. The ground wires connecting the main battery to the Main PCB have a poor connection. 2. Analog to Digital measurement error on Main PCB.	1. Verify continuity between the main battery ground wires and the Main PCB. Break may be hidden by shrink wrap at the battery connection side. Resolder or replace wires if needed. 2. Check the Analog to Digital offset and replace the Main PCB if abnormal.
141	Unexpected power down message/ Error	1. A power-down message was received without an associated POWER Key press.	1. Visually inspect Main PCB for disconnected wires or improperly seated ICs. If problem persists, replace the Main PCB.
142	Unspecified Door Processor Error/ Error	1. Default door error message.	1. Check cables and connectors to door and pressure transducer. Replace the Door/Bezel Assembly, see page 131. 2. Replace the Main Circuit Board, see page 126.
143	Display EEPROM Error/ Error	1. EEPROM failure on display board.	1. Check cables and connectors to door. Replace the LCD PCB assembly. 2. Replace the Main Circuit Board, see page 126. 3.
144	Door Processor LCD Controller Memory Error/ Error	1. Memory error on door processor LCD controller.	1. Check door cable and connectors. Replace the LCD PCB assembly.

Code	Alarm/ User Message	Probable Cause	Corrective Action
145	Floating Point Math Error/ Error	1. Floating point error detected.	1. Retry operation and if error continues, replace the Main Circuit Board, see page 126.
146	Qx Overlap Error/ Error	1. Overlap in (q)x run detected.	1. Retry operation and if error continues, replace the Main Circuit Board, see page 126.
147	PRAM Control Error/ Check Set	1. PRAM element not checked out. 2. Too many PRAM elements are checked out.	1. PRAM will automatically re-initialize. 2. Power cycle the pump and re-dock.
148	PRAM List Error/ Check Set	1. PRAM checksum is in error.	1. PRAM will automatically re-initialize. 2. Power cycle the pump and re-dock.
149	Unexpected Back Alarm/ Error	1. Battery is overcharged.	1. Replace the Main Circuit Board, see page 126.

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8.4 SYSTEM TROUBLESHOOTING

The following table lists all alarms potentially generated in the Outlook software. Each alarm is identified with a number which may appear on the display during the alarm or immediately upon power up after a "SYSTEM" alarm.

Alarm/ User Message	Probable Cause	Corrective Action
Pump will not operate on AC	1. Power cord cut or loose. 2. Power supply failure. 3. Main PCB failure. 4. Key panel failure. 5. Door processor or LCD PCB failure. 6. Fluid intrusion.	1. Check the cord for continuity and placement. 2. Replace the Main Circuit Board, see page 126. 3. Replace the key panel. 4. Replace the LCD PCB assembly. 5. Open pump and look for evidence of fluid intrusion. If found, wipe off all damp components and allow to dry thoroughly before attempting operation again. If unsuccessful, return the pump for service.
Pump does not power off with door closed	1. Key panel failure. 2. Main PCB failure. 3. Door processor or LCD PCB failure. 4. Fluid intrusion.	1. Replace the key panel. 2. Test main board by shorting the on/off pads on the front of the main board. Replace the Main Circuit Board, see page 126. 3. Replace the LCD PCB. 4. Open pump and look for evidence of fluid intrusion. If found, wipe off all damp components and allow to dry thoroughly before attempting operation again. If unsuccessful, return the pump for service.
Pump emits continuous high pitched sounding alarm and will not turn on	1. Low battery condition. 2. Defective power supply. 3. Main PCB failure. 4. Short in additional subassemblies.	1. Plug the pump in and cycle the power on and off then allow it to recharge. 2. Replace power supply. 3. Replace the Main Circuit Board, see page 126. 4. Isolate defective subassembly(ies).
Pump slips down pole	1. Pump improperly mounted on pole. 2. Foreign material on pole such as a lubricant. 3. QuickClamp™ mechanism failure.	1. The clamp may have been locked before it was tightened. 2. Clean the pole of all foreign materials. 3. Check to ensure that the rubber material is firmly in place and reapply with an approved adhesive material. 4. Check for cracks in QuickClamp plastic assembly and replace the clamp mechanism if any are found. 5. Check that I.V. pole is within specifications (0.85" to 1.25")

Alarm/ User Message	Probable Cause	Corrective Action
LCD has no back-light	1. LCD Display PCB failure 2. Short between the right side of the LCD PCB and the inside of the cosmetic bezel, when pressure is applied the that portion of the cosmetic bezel.	1. Replace the LCD Display PCB. 2. Verify that the insulating tape is properly covering the right side of the LCD PCB and the metal clip inside the right edge of the cosmetic bezel.
LCD flickers erratically or goes blank	1. Low battery condition. 2. Cable between the door and the mechanism has dislodged. 3. LCD assembly failure. 4. LCD PCB failure. 5. Bent pin on the 100 pin main board connector.	1. Plug the pump in and verify that the LCD works correctly. 2. Reseat the connector. 3. Replace the LCD assembly. 4. Replace the LCD PCB assembly. 5. Straighten the pin and re-connect.
Pump will not operate on battery	1. Battery has completely discharged. 2. Battery cables may be damaged. 3. Fuse number 2 on Main PCB has been damaged or loose. 4. Main PCB failure.	1. Plug the pump in and allow it to fully recharge before attempting battery operation. 2. Check battery cables and connectors for damage. 3. Inspect the fuse and replace as needed. 4. Replace the Main Circuit Board, see page 126.
Unable to download operation log, DoseGuard™ alert log, alarm log, or configuration	1. Pump not placed in proper mode. 2. Cables and/or connectors are not properly seated. 3. Cable not in serial port. 4. Cables and/or connectors are damaged.	1. Put pump in Biomed menu. Access operation alert, or alarm log and select transmit with P.C. in Outlook™ WinDock Program, receive operation log. 2. Check cable connections. 3. Ensure cable is in serial port (9 pin). 4. Ensure that the connectors between the pump and the computer are not damaged. Try an alternate cable.
Unable to perform panel lockout.	1. Pump not infusing. 2. Panel lock out switch failure. 3. Main PCB failure.	1. Pump must be infusing to activate lock out. 2. Verify that the switch is being depressed properly, is not bent or damaged. 3. Replace the Main Circuit Board, see page 126.
No audible alarm.	1. Main alarm speaker has failed. 2. Connector to the speaker has dislodged. 3. Main PCB failure.	1. Replace the speaker assembly. 2. Reseat the connector. 3. Replace the Main Circuit Board, see page 126.
Pump makes a grinding or ratcheting noise upon power up or down. Immediately gives System Error	1. Main motor is jammed.	1. Remove main motor from mechanism. Unscrew carriage driver from shaft of main motor. Lubricate with CRC brand silicone spray and re-assemble.

Alarm/ User Message	Probable Cause	Corrective Action
LCD scrolling	1. LED board failure. 2. LCD failure. 3. Main PCB failure.	1. Examine for poor or misaligned connections. Replace LED PCB or replace the LED display board. 2. Replace the LCD display if necessary. 3. Replace the Main Circuit Board, see page 126.
Displays flash on and off	1. Pump processor EPROM failure. 2. Pump processor failure. 3. Main PCB failure.	1. Replace the Main Circuit Board, see page 126.
LED displays Err 5	1. LED display PCB failure. 2. Main PCB failure.	1. Replace the LED display PCB. 2. Replace the Main Circuit Board, see page 126.
Short operating time to LOW BATT alarm	1. Main battery in a low condition. 2. Main battery no longer accepts a charge. 3. Main PCB failure.	1. Plug the pump in and allow it to fully recharge. Inspect Fuse 2 on the Main PCB. 2. Replace the battery (recommended at 2-year intervals). 3. Replace the Main Circuit Board, see page 126.
Durg Library displays "Undefined_xx" for Drug Names.	1. PRAM memory corruption, configuration setting lost. 2. 3V Lithium battery failure. 3. System Error 75 event, configuration setting lost.	1. Reload the configuration file using a configuration file from a compatible pump. See Outlook™ WinDock™ Operation Manual. 2. Replace 3V Lithium battery, see page 121. 3. Power-cycle the pump then reload the configuration file using a configuration file from a compatible pump. See Outlook™ WinDock™ Operation Manual.

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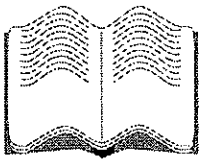
CHAPTER 9.0
REMOVAL & INSTALLATION PROCEDURES



IN THIS CHAPTER YOU WILL LEARN:

- What tools/equipment are required to repair the pump.
- How to repair and/or replace the major subassemblies of the pump.
- What tests are required after each repair.

WARNING: Shock Hazard. Prior to disassembling or performing service on the Outlook Pump, it is recommended the pump be disconnected from the AC power source unless it is specifically required for a particular test. If it is necessary to have the device connected to an AC power source, use a line isolation transformer and caution. Failure to do so could result in bodily harm.

WARNING: Shock Hazard. The inside of the Outlook case has a conductive coating which is connected to ground through the power supply module. When servicing the Outlook, use caution to prevent accidental shorting to this coating. Failure to do so may result in component damage or even bodily harm if a line isolation transformer is not used when the AC power supply cord has not been disconnected.

CAUTION: The Outlook 200 is a class 2 laser product according to IEC 60825-1 standard. LASER RADIATION - Do Not Stare Into Beam.

NOTE: It is good practice to wear eye protection while servicing the pump, especially during assembly and disassembly operations.

9.1 REPAIR TOOLS & PARTS

It is the intent of B. Braun to allow the Biomedical Service Professional to repair and/or replace most of the subassemblies, which represents our present procedure with other infusion devices that we manufacture. We do, however, require the Biomedical Service Professional to be certified by attending a B. Braun Repair Training class. If you wish to repair the device

yourself and have any questions regarding training classes, please contact an authorized B. Braun Service Center (refer to 1.4.1).

9.1.1 Hand Tools

The table below describes the hand tools necessary to disassemble and reassemble various parts of the Outlook Pump for checkout and repair.

Tool Description	Size
Phillips Head Screwdriver	#1 and #2
Small Blade Screwdriver	1/8" and 1/4" wide
Needle Nose Pliers	
Standard Pliers	
Hex Key Set	
X-acto® Knife	

The table below describes the consumable materials necessary for the maintenance and repair of the Outlook Pump.

Description	Recommended Manufacturer
RTV 3140, P/N 145005	Dow Corning 3140 RTV
70% Isopropyl Alcohol	
High Bond Adhesive	Henkel Adhesives Corp. Sicoment 8300
Silicone Spray	CRC heavy Duty Silicone (available at many hardware stores)
Clear Lithium Grease	Permatex Industrial Super Lube. Multipurpose Synthetic Lubricant with Teflon.
Cotton Swabs	Johnson & Johnson
Alcohol	
Locktite 222	
Low Temp Hot Melt	

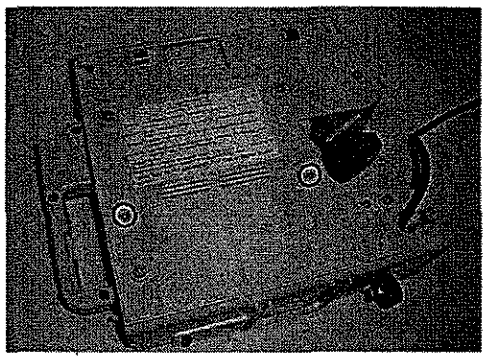
9.1.2 Spare Parts

A spare parts kit, standardized or custom designed, is available to provide parts and assemblies routinely required to service the Outlook pump. Other non-generic Outlook pump parts may be ordered on an individual basis when required. Common, generic parts (screws, nuts, wire, etc.) are more readily available from suppliers in your area. Therefore, these parts are not available for sale through B. Braun.

9.2 BATTERIES

9.2.1 12 Volt Lead-Acid Battery

9.2.1.1 Removal-Battery



1. On bottom of pump, remove the 2 screws that attach the battery door
2. Remove the battery
3. Unplug the wire leads from the battery

9.2.1.2 Installation-Battery

1. Plug the wire leads into the new battery.
2. Insert the battery into the compartment.
3. Replace the 2 screws that attach the battery door.

9.2.1.3 Testing

1. Complete section 6.10 of the Performance Check in Chapter 6.0 if the battery is being replaced.

9.2.2 3 Volt Lithium Battery

CAUTION: Do not attempt to recharge, disassemble, heat, or dispose of the lithium battery in fire!

ATTENTION: Only use a B. Braun specified lithium replacement battery!

9.2.2.1 Removal-Battery

1. Remove the Main Circuit Board (refer to 9.5.1)
2. Unsolder and remove the battery

9.2.2.2 Installation-Battery

1. Re-solder the battery onto the Main Circuit Board.
2. Replace the Main Circuit Board (refer to 9.5.2).

9.2.2.3 Testing

1. Complete sections 6.4, 6.5, 6.8.2, 6.8.3, and 6.9 of the Performance Check in Chapter 6.0.

9.2.3 4.8 Volt NiCAD Battery

9.2.3.1 Removal-Battery

1. Remove the Main Circuit Board (refer to 9.5.1)
2. Unsolder and remove the battery pack.

9.2.3.2 Installation-Battery

1. Re-solder the battery pack onto the Main Circuit Board.
2. Replace the Main Circuit Board (refer to 9.5.2).

9.2.3.3 Testing

1. Complete sections 6.4, 6.5, 6.8.2, 6.8.3, and 6.9 of the Performance Check in Chapter 6.0.

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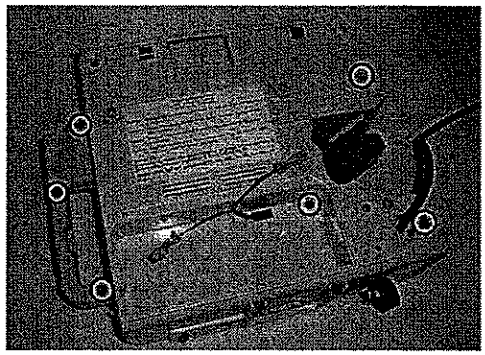
9.3 CASE TOP

9.3.1 Removal-Case Top

1. Remove the battery (refer to 9.2.1)
2. Remove the 6 screws that attach the case top. Note that 1 of the screws is in the battery compartment
3. Carefully turn the pump over (right side up), holding the case top in place
4. Lift the case top off from the case bottom a couple of inches. This will allow access to the hand-held scanner cable. Unplug this cable from the main circuit board. The case top can be completely removed.



9.3.2 Installation-Case Top

1. Hold the case top over the case bottom and plug in the hand-held scanner cable into the main circuit board
2. Place the case top onto the case bottom
3. Carefully turn the pump over (bottom up), holding the two halves together
4. Replace the 6 screws that attach the case top
5. Replace the battery and the battery door (refer to 9.2.2)

9.3.3 Testing

1. Check that all screws are tightened and secure.

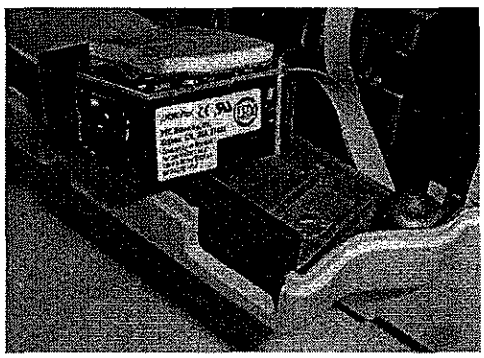
9.4 INTERNAL SCANNER

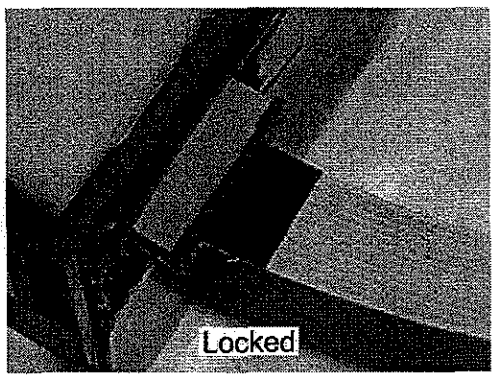
CAUTION: The Outlook 200 is a class 2 laser product according to IEC 60825-1 standard. LASER RADIATION - Do Not Stare Into Beam

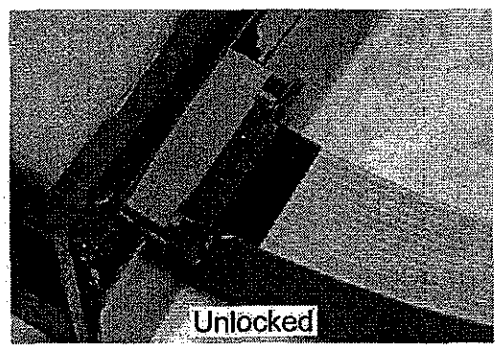
There is no service adjustment for the laser scanner. Do not attempt to adjust or repair the scanner. Unplug and power down the Outlook pump before attempting to replace the scanner.

9.4.1 Removal-Internal Scanner

1. Remove the battery (refer to 9.2.1)
2. Remove the case top (refer to 9.3.1)
3. Lift the scanner from the mounting cavity in the case
4. Unlock the ribbon connector and remove scanner







9.4.2 Installation-Internal Scanner

NOTE: Must have the foam tape in place as shown on the top of the scanner.

NOTE: Ensure the aperture lens for the internal scanner is in place prior to replacing the case top.

1. Lock the ribbon connector
2. Replace the scanner in the mounting cavity
3. Replace the case top (refer to 9.3.2)
4. Replace the battery (refer to 9.2.2)

9.4.3 Testing

1. Complete sections 6.8.2 and 6.8.3 of the Performance Check in Chapter 6.0.

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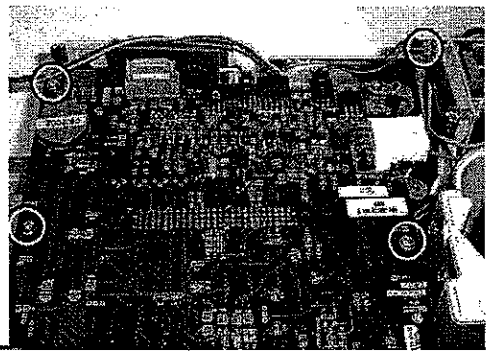
9.5 MAIN CIRCUIT BOARD

9.5.1 Removal-Main Circuit Board

1. Remove the case top (refer to 9.3.1)
2. Unplug all connectors from the main board
   - Power supply
   - Fan
   - Multifunction connector
   - Internal scanner
3. Remove the 3 screws which mount the board to the case bottom, and remove the ground strap from the power supply frame (fastened by 2 nuts)
4. Remove the main board.



NOTE: The 100 pin connector on the bottom side of the board is attached to the mechanism assembly – this will offer some resistance.

9.5.2 Installation-Main Circuit Board

1. Place the main board back into position
2. Replace the 3 screws which mount the board to the case bottom and replace the ground strap from the power supply frame
3. Plug in the power supply, fan, multifunction connector, and internal scanner connectors into the main board
4. Replace the case top (refer to 9.3.2)

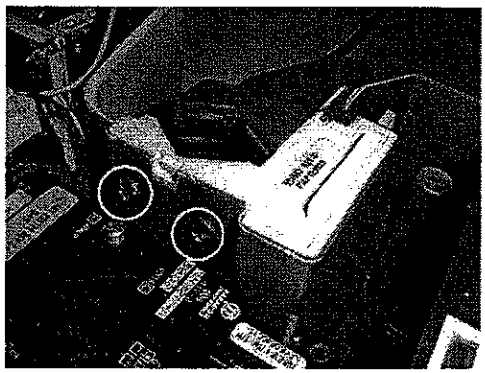
9.5.3 Testing

1. Complete sections 6.4, 6.5, 6.8.2 and 6.8.3, and 6.9 of the Performance Check in Chapter 6.0.

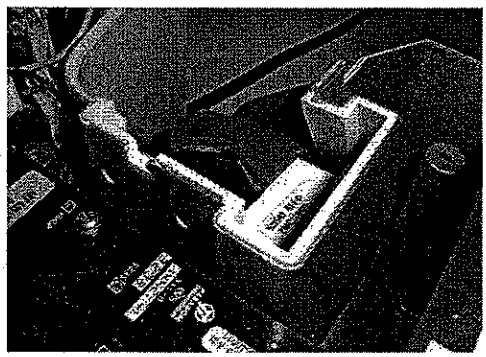
9.6 POLE CLAMP ASSEMBLY

9.6.1 Removal-Pole Clamp Assembly

1. Remove the battery (refer to 9.2.1)
2. Remove the case top (refer to 9.3.1)
3. Remove the 2 screws that attach the pole clamp frame to the case bottom
4. Twist the frame to allow the snap fit feature (between the screws) to un-snap



5. Pull downward to slide the pole clamp assembly out of the case bottom



9.6.2 Installation-Pole Clamp Assembly

1. Slide the pole clamp assembly up into the case bottom
2. Twist the frame to re-engage the snap fit feature (between the screws)
3. Replace the 2 screws that attach the pole clamp frame to the case bottom
4. Replace the case top (refer to 9.3.2)
5. Replace the battery (refer to 9.2.2)

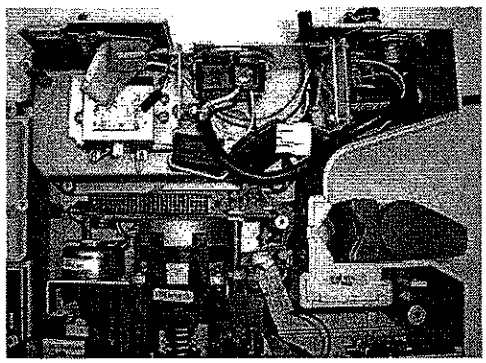
9.6.3 Testing

1. Complete sections 6.2.2.3 and 6.2.2.4 of the Performance Check in Chapter 6.0.

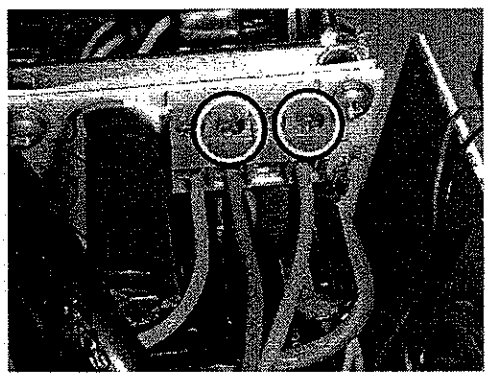
9.7 POWER SUPPLY

9.7.1 Removal-Power Supply

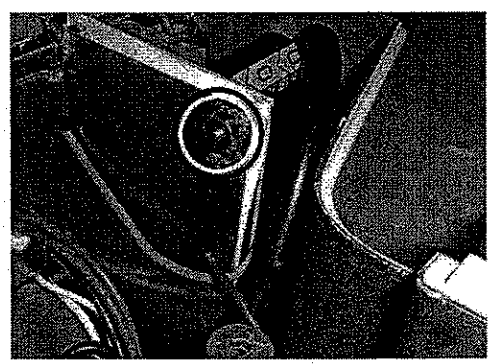
1. Remove the battery (refer to 9.2.1)
2. Remove the case top (refer to 9.3.1)
3. Remove the main circuit board (refer to 9.5.1)
4. On the power supply



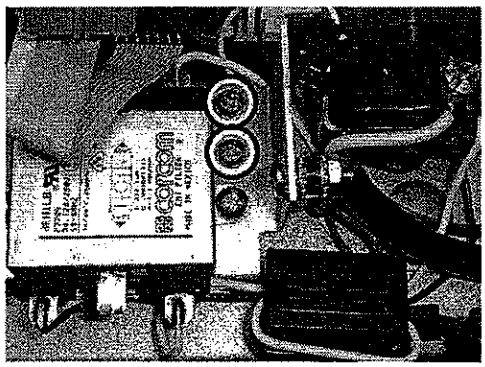
- disconnect the two power wires



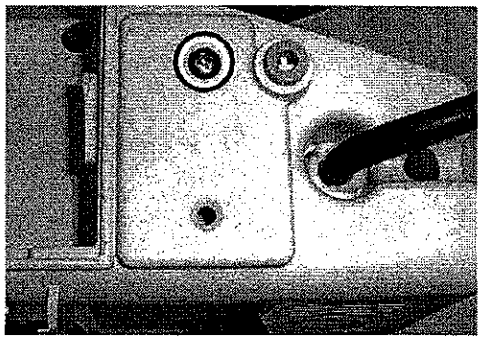
- and disconnect the green wire



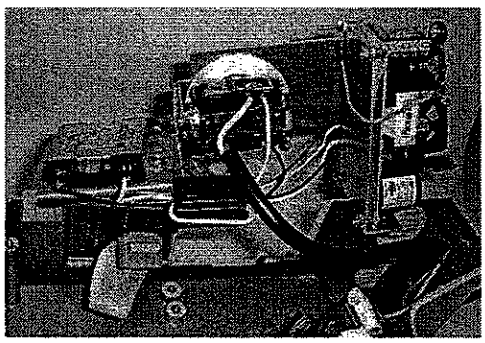
5. Remove the two screws that attach the assembly to the case bottom



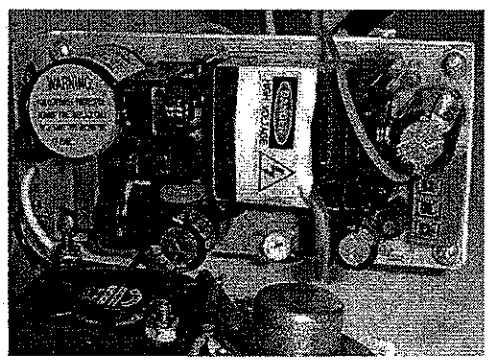
6. Turn the case bottom over and remove the external mounting screw



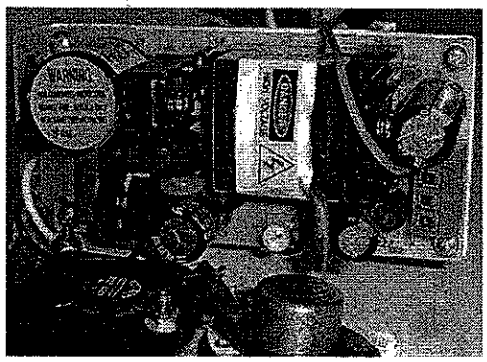
7. Remove the power supply assembly from the case bottom



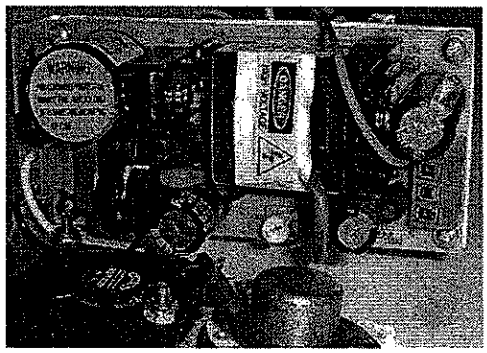
8. Remove the ground wire



9. Remove the connector attaching the cable from the filter



10. Remove the 4 screws and standoffs attaching the power supply to the metal frame



9.7.2 Installation-Power Supply

1. Replace the 4 screws and standoffs which attach the power supply to the metal frame
2. Replace the connector attaching the cable to the filter
3. Replace the ground wire
4. Replace the power supply assembly into the case bottom
5. Turn the case bottom over and re-install the external mounting screw
6. Replace the two screws that attach the assembly to the case bottom
7. On the power supply, reconnect the green wire and the two power wires
8. Replace the main circuit board (refer to 9.5.2)
9. Replace the case top (refer to 9.3.2)
10. Replace the battery (refer to 9.2.2)

9.7.3 Testing

1. Complete sections 6.2.2.4, 6.8, and 6.9 of the Performance Check in Chapter 6.0.

9.8 DOOR/BEZEL ASSEMBLY

9.8.1 Removal-Door/Cosmetic Bezel Assembly

1. Remove the battery (refer to 9.2.1)
2. Remove the case top (refer to 9.3.1)
3. Remove the main circuit board (refer to 9.5.1)
4. Remove the grounding wire from the metal bracket.
5. With the door closed, lift the door/bezel assembly from the case bottom assembly

9.8.2 Installation-Door/Bezel Assembly

1. Place the case bottom on the work surface such that the channel guides nearest the front of the case bottom are easily visible. Usually this is with the front facing you and the case feet touching the work surface.
2. Locate the grooves on each side of the door/bezel assembly that run parallel to the face of the bezel
3. Hold the door/bezel assembly in both hands. Position the grooves in the half door/bezel assembly over the two channel guides in the case bottom. Allow the unit to slide down into the case bottom taking care NOT to force the fit. The fit should be snug with the top of the channel guides and flush with the top of the grooves.
4. View the assembled unit from the top making sure the door/bezel assembly is not misaligned in the case bottom. The door/bezel assembly grooves should fit squarely onto the channel guides. If not, remove and check for any obstruction, then reinstall.
5. Reattach the grounding wire to the metal bracket.
6. Replace the main circuit board (refer to 9.5.2)
7. Replace the case top (refer to 9.3.2)
8. Replace the battery (refer to 9.2.2)

9.8.3 Testing

1. Complete sections 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8.2, 6.8.3, 6.11, 6.12 and 6.13 of the Performance Check in Chapter 6.0.

9.9 DOOR ASSEMBLY

9.9.1 Removal-Door Assembly

1. Remove the battery (refer to 9.2.1)
2. Remove the case top (refer to 9.3.1)
3. Remove the main circuit board (refer to 9.5.1)
4. Remove the door/bezel assembly (refer to 9.8.1)
5. Remove the door from the door/bezel assembly by opening the door. Look down at the two metal clips at the hinge. Pop the metal clips with a flat head screw driver.
6. Disconnect the door cable from the interface board.

9.9.2 Installation-Door Assembly

1. Connect the door cable to the interface board.
2. Replace the metal clips at the hinge.
3. Replace the door/bezel assembly (refer to 9.8.2)
4. Replace the main circuit board (refer to 9.5.2)
5. Replace the case top (refer to 9.3.2)
6. Replace the battery (refer to 9.2.2)

9.9.3 Testing

1. Complete sections 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8.2, 6.8.3, 6.11, 6.12 and 6.13 of the Performance Check in Chapter 6.0.

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9.10 COSMETIC BEZEL & KEYPANEL ASSEMBLY

9.10.1 Removal-Cosmetic Bezel & Keypanel Assembly

1. Remove the 3 Phillips head screws on the bottom of the door
2. Remove the cosmetic bezel by prying the snaps along the top
3. Carefully disconnect the ribbon cables from the LED PCB

9.10.2 Installation-Cosmetic Bezel & Keypanel Assembly

1. Reconnect the ribbon cables from the LED PCB
2. Replace the cosmetic bezel, snapping it into place along the top
3. Replace the 3 Phillips head screws on the bottom of the door

9.10.3 Testing

1. Complete sections 6.3, 6.8.2 and 6.8.3 of the Performance Check in Chapter 6.0.

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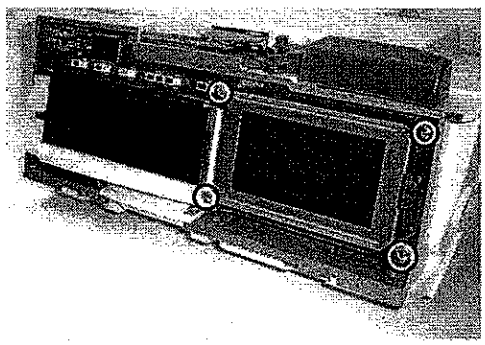
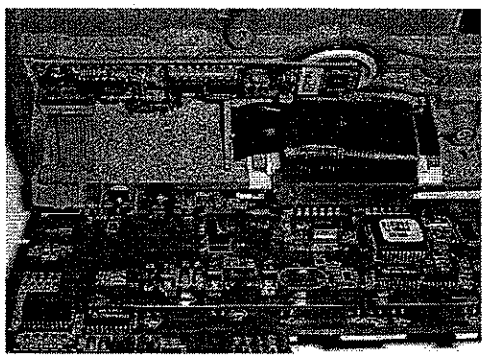
9.11 DISPLAY BOARD ASSEMBLY

9.11.1 Removal-Display Board Assembly

1. Remove the cosmetic bezel and keypanel assembly (refer to 9.10.1)
2. Remove the 4 screws that attach the display board to the door
3. Remove the insulator



4. Tilt the display board forward and unplug the connectors
5. Lift the display board from the door



9.11.2 Installation-Display Board Assembly

1. Replace the display board in the door
2. Plug in the connectors to the display board
3. Replace the insulator
4. Replace the 4 screws that attach the display board to the door
5. Replace the cosmetic bezel and keypanel assembly (refer to 9.10.2)

9.11.3 Testing

1. Complete sections 6.3, 6.4, 6.8.2 and 6.8.3 of the Performance Check in Chapter 6.0.

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9.12 MAIN BEZEL

9.12.1 Removal-Main Bezel

1. Remove the 12V battery (refer to 9.2.1)
2. Remove the case top (refer to 9.3.1)
3. Remove the main circuit board (refer to 9.5.1)
4. Remove the door/bezel assembly (refer to 9.8.1)
5. Remove the door assembly (refer to 9.9.1)

9.12.2 Installation-Main Bezel

1. Replace the door assembly (refer to 9.9.2)
2. Replace the door/bezel assembly (refer to 9.8.2)
3. Replace the main circuit board (refer to 9.5.2)
4. Replace the case top (refer to 9.3.2)
5. Replace the 12V battery (refer to 9.2.1)

9.12.3 Testing

1. Complete sections 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8.2, 6.8.3, 6.11, 6.12 and 6.13 of the Performance Check in Chapter 6.0.

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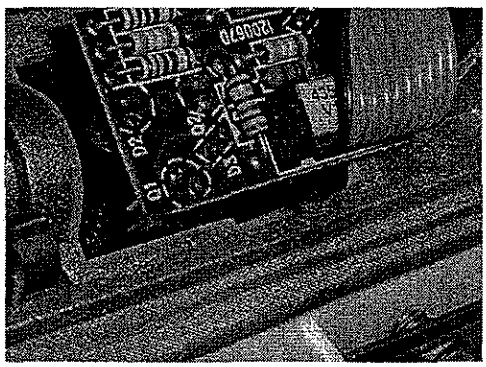
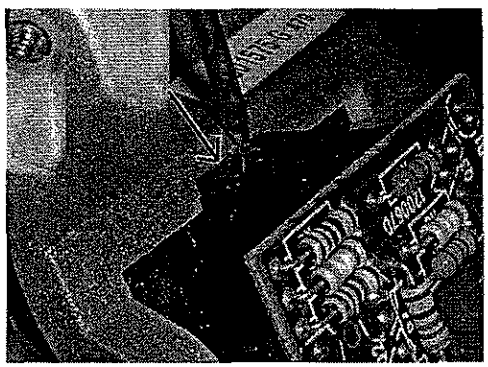
9.13 AIR-IN-LINE ASSEMBLY (SENSOR AND CIRCUIT BOARD)

9.13.1 Removal- Air-In-Line Assembly

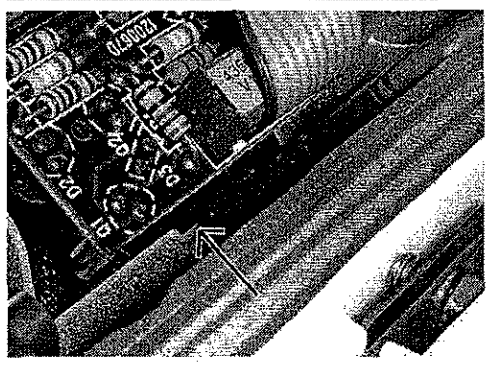
1. Remove the battery (refer to 9.2.1)
2. Remove the case top (refer to 9.3.1)
3. Remove the main circuit board (refer to 9.5.1)
4. Remove the door/bezel assembly (refer to 9.8.1)
5. Disconnect J5 (Air-In-Line) 10-pin ribbon cable connector from the header on the Interface PCB



6. Remove the cable clamp from the Air-In-Line ribbon cable
7. Open the door on the door/bezel assembly

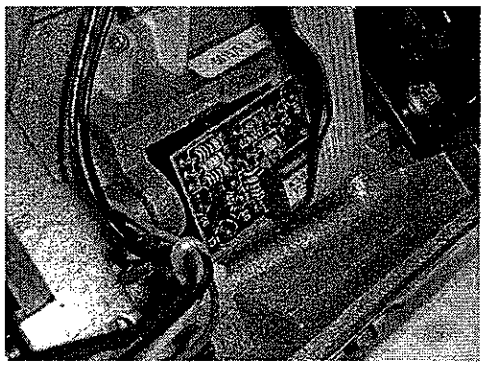


8. Use a small flat head screwdriver to press on the two Air-In-Line retaining clamps from the back of the bezel assembly



9. Push the Air-In-Line assembly toward the door

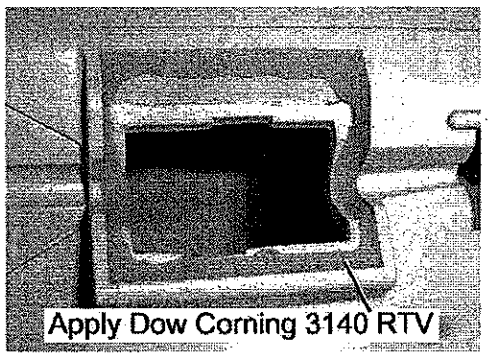
10. Remove the Air-In-Line assembly from the door/bezel assembly



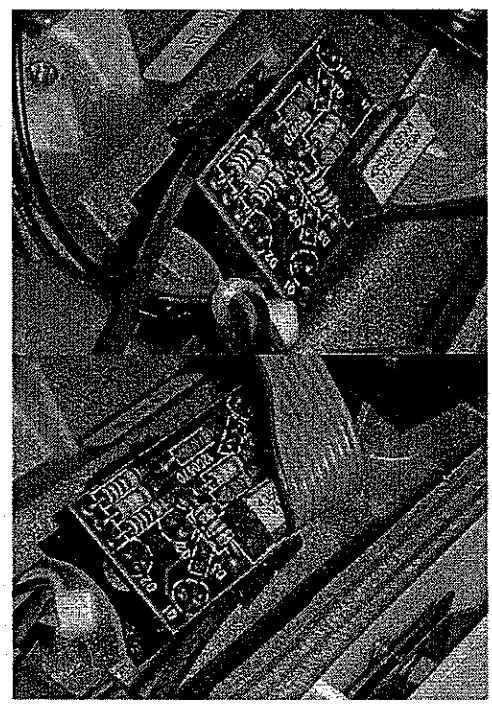
11. Clean the RTV silicone rubber coating around the Air-In-line area on the bezel assembly

9.13.2 Installation-Air-In-Line Assembly

1. Apply new RTV silicone rubber coating around the opening in the bezel for the Air-In-Line assembly



2. Install the Air-In-Line assembly into the bezel assembly. Use a small flat head screwdriver to snap the two Air-In-Line retaining clamps in place



CAUTION: Air-In-Line retaining clamps can break with excessive force.

3. Clean excess RTV coating around the edge of the Air-In-Line area, if any.
4. Connect the Air-In-Line 10-pin connector to header J5 on the Interface PCB. Make sure that pin 1 on the 10-pin cable connector and pin 1 on header J5 on the Interface PCB are properly aligned.
5. Gather loose wires from the Air-In-Line assemblies and position in the cable clamp.
6. Align the cable clamp with the hole in the restriction bracket and install the nylon snap rivet.

CAUTION: Take care not to allow RTV into the tubing channel of the Air-In-Line assembly.

7. Replace the door/bezel assembly (refer to 9.8.2)
8. Replace the main circuit board (refer to 9.5.2)
9. Replace the case top (refer to 9.3.2)
10. Replace the battery (refer to 9.2.2)

9.13.3 Testing

1. Complete sections 6.2.3.2, 6.3, 6.4, 6.5, 6.8.2 and 6.8.3 of the Performance Check in Chapter 6.0.

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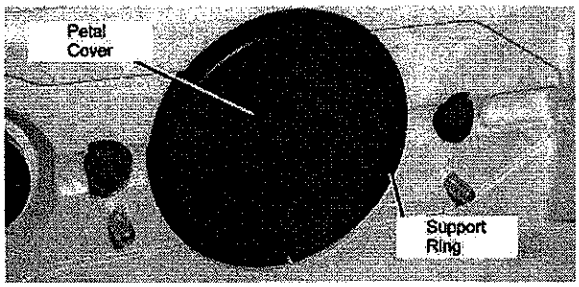
9.14 PETAL COVER ASSEMBLY

9.14.1 Removal-Petal Cover Assembly

1. Position the pump with the door facing you.
2. Open the door until the face is flat on the work surface.
3. Using the small flat blade screw driver, gently pry loose the black plastic snap ring that holds the petal cover in position.
4. Remove the petal cover.



9.14.2 Installation-Petal Cover Assembly

1. Attach the petal cover over the petal module. The concave portion should be facing the petal module.
2. Snap the petal cover retaining ring in place.

9.14.3 Testing

1. Complete sections 6.4 and 6.6 of the Performance Check in Chapter 6.0.

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APPENDIX

SAMPLE OPERATION LOG

Below is an example of a portion of an Operation Log as will be seen when viewing the file on your computer. If the log is full, the print out will be approximately 20-24 pages long, with the most recent event placed at the end of the printout:

VERSION XXX
B. Braun
Outlook Operation Log

ACH = active channel
ALM = alarm
ALV = alarm volume
APG = allow program
ATV = allow time & vol
CAT = drug category
CMD = current mode
DDU = dose drug units
DMX = DoseGuard maximum
DPU = dose patient unit
DRT =dose rate
DTU = dose time units
FLV = flush volume
GPD =program period
GSV = program set volume
IPR = infusion pressure
IPV =initial pressure
KOR = KVO rate
LST = line status
MMD = micro mode
PCR = profile current rate
PDV = ramp down vol
PLR = profile level rate
PRR = profile ramp rate
PTT = profile total time
PUT = profile ramp up time
PVL = profile volume
QXS = qx start time
QXR = qx rate
QXV = qx total volume
SLV =STD last volume
SBV =STD piggyback volume
SPV = STD primary volume
TDY = day
TI = total infused
TMO = month
VTD = volume to deliver

AFL = allow flush
ALT = alternate alarm
APF = allow profile
APY = allow piggyback
BLV = battery level
CDU = dose concentration units
DDA = dose drug amount
DMN = DoseGuard minimum
DOS = dosage
DPW = dose patient weight
DSV = dose solution vol
DVL = dose volume
GCV = program current vol
GSR = program set rate
IDS = initial data start-up
IPT = pressure start-up type
IST = infusion status
LCN = LCD contrast
MKC =key click signal
MTS = transition signal
PDT =ramp down time
PHU =patient height unit
PMR =profile max rate
PST = profile stage
PTV = profile total volume
PUV =profile ramp up vol
PWU = patient weight unit
QXI = QX interval
QXD = QX dose volume
REM = time remaining
SBR = STD piggyback rate
SPR = STD primary rate
STRT= start time
THR = hour
TMN = minute
UPR = user pressure
ZTM = pause time

STANDARD POWER UP
ACH = PRIMARY SPR = 0.0 SPV = 0.0 SBR = 0.0 SBV = 0.0
UPR = 300 TI = 0.0 REM =10 hours 0 minutes
TMO = 11 TDY = 5 THR = 10 TMN = 4 LST =Uninitialized BLV = 0

MENU SETTINGS
ALV = HIGH LCN = 7 IDS = POWER UP IN STANDARD MODE
MMD = Adult IPT = FIXED IPV = 300
APF = Profile Enabled APG = Program Disabled
ATV = Time Vol Disabled APY = Piggyback Enabled
MTS = Disabled ALT= Off MKC = Enabled
TMO = 11 TDY = 5 THR = 10 TMN = 4

PRIMARY START
ACH = PRIMARY SPR = 100.0 SPV = 100.0 SBR = 0.0 SBV 0.0
UPR = 300 TI = 0.0 REM = 1 hours 0 minutes
TMO = 11 TDY = 5 THR = 10 TMN = 5 LST = Battery BLV = 95

STANDARD ALARM
ALM = 24 Downstream Occlusion
ACH = PRIMARY SPR = 100.0 SPV = 98.7 SBR = 0.0 SBV 0.0
UPR = 300 TI = 1.3 REM = 0 hours 58 minutes
TMO = 11 TDY = 5 THR = 10 TMN = 7 LST = Battery BLV = 78

STANDARD HOLD
ACH = PRIMARY SPR = 100.0 SPV = 98.7 SBR = 0.0 SBV 0.0
UPR = 300 TI = 1.3 REM = 1 hours 0 minutes
TMO = 11 TDY = 5 THR = 10 TMN = 7 LST = Battery BLV = 78

PRIMARY START
ACH = PRIMARY SPR = 100.0 SPV = 98.7 SBR = 0.0 SBV 0.0
UPR = 300 TI = 1.3 REM = 0 hours 58 minutes
TMO = 11 TDY = 5 THR = 10 TMN = 7 LST = Battery BLV = 78

KVO START
CMD = Standard KOR = 3.0 UPR = 300 TI = 100.0
TMO = 11 TDY = 4 THR = 11 TMN = 5 LST = Battery BLV = 75

STANDARD HOLD
ACH = PRIMARY SPR = 100.0 SPV = 0.0 SBR = 0.0 SBV 0.0
UPR = 300 TI = 100.0 REM = 0 hours 0 minutes
TMO = 11 TDY = 5 THR = 11 TMN = 7 LST = Battery BLV = 65

HOLD EXTEND START
CMD = Standard ZTM = 0 hr 3 min 0 sec
TMO = 11 TDY = 5 THR = 11 TMN = 7 LST = AC

HOLD EXTEND END
CMD = Standard ZTM = 0 hr 2 min 54 sec
TMO = 11 TDY = 5 THR = 11 TMN = 7 LST = AC

PRIMARY START
ACH = PRIMARY SPR = 100.0 SPV = 20.0 SBR = 0.0 SBV = 0.0
UPR = 300 TI = 100.0 REM = 0 hours 12 minutes
TMO = 11 TDY = 5 THR = 11 TMN = 8 LST = AC BLV = 0

STANDARD ALARM
ALM = 9 System Alarm
ACH = PRIMARY SPR = 100.0 SPV = 20.0 SBR = 0.0 SBV = 0.0
UPR = 300 TI = 100.0 REM = 0 hours 12 minutes
TMO = 11 TDY = 5 THR = 11 TMN = 8 LST = AC BLV = 0

STANDARD HOLD
ACH = PRIMARY SPR = 100.0 SPV = 20.0 SBR = 0.0 SBV = 0.0
UPR = 300 TI = 100.0 REM = 0 hours 12 minutes
TMO = 11 TDY = 5 THR = 11 TMN = 8 LST = AC BLV = 0

PRIMARY START
ACH = PRIMARY SPR = 80.0 SPV = 20.0 SBR = 0.0 SBV = 0.0
UPR = 300 TI = 0.0 REM = 0 hours 15 minutes
TMO = 11 TDY = 5 THR = 11 TMN = 8 LST = AC BLV = 0

STANDARD ALARM
ALM = 22 Air-in-Line
ACH = PRIMARY SPR = 80.0 SPV = 7.0 SBR = 0.0 SBV = 0.0
UPR = 300 TI = 13.0 REM = 0 hours 5 minutes
TMO = 11 TDY = 5 THR = 11 TMN = 8 LST = AC BLV = 0
DOSE OUT OF RANGE
DDU = MICROGRAMS DPU = KILOGRAMS DTU = MINUTES
PWU = KILOGRAMS PHU = CENTIMETERS CDU = MILLIGRAMS
DRT = 300.0 DVL = 24.6 DOS = 20.0
DPW = 50.0 DPH = 0.0 DDA = 20.0 DSV = 100
DRG = ALFENTANIL CAT = ICU/CCU
DMN = 2.00 DMAX = 20.0
TMO = 1 TDY = 28 THR = 16 TMN = 18 LST = AC BLV = 99

DOSE TITRATE
DDU = MICROGRAMS DPU = KILOGRAMS DTU = MINUTES
PWU = KILOGRAMS PHU = CENTIMETERS CDU = MILLIGRAMS
DRT = 300.0 DVL = 24.6 DOS = 20.0
DPW = 50.0 DPH = 0.0 DDA = 20.0 DSV = 100
DRG = ALFENTANIL CAT = ICU/CCU
DMN = 2.00 DMAX = 20.0
TMO = 1 TDY = 28 THR = 16 TMN = 18 LST = AC BLV = 99

PRIMARY TITRATE ABORT
TMO = 1 TDY = 28 THR = 16 TMN = 18 LST = AC BLV = 99

DOSEGUARD ALERT
DDU = MICROGRAMS DPU = KILOGRAMS DTU = MINUTES
PWU = KILOGRAMS PHU = CENTIMETERS CDU = MILLIGRAMS
DRT = 400.0 DVL = 24.2 DOS = 26.7
DPW = 50.0 DPH = 0.0 DDA = 20.0 DSV = 100
DRG = ALFENTANIL CAT = ICU/CCU
DMN = 2.00 DMAX = 20.0
TMO = 1 TDY = 28 THR = 16 TMN = 18 LST = AC BLV = 99

B|BRAUN
SHARING EXPERTISE

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